Australasian Plant Conservation

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Conservation management of linear vegetation remnants in Australia

Leading practice in the environmental management of New South Wales linear reserves—the role of the NSW Roadside Environment Committee

Havens and oases—the conservation value of stock routes in Queensland

Restoring critically endangered grassland on roadsides in the Victorian Volcanic Plain

Tasmania's temperate grassland linear remnants and the Tunbridge long paddock

Threatened flora and Western Australia's roadside remnants

And much much more …

SPECIAL THEME: PLANT CONSERVATION AND LINEAR VEGETATION REMNANTS

ANPC National Office

GPO Box 1777
Canberra, ACT 2601, Australia
Ph: (02) 6250 9509
Fax: (02) 6250 9528
Email: anpc@anpc.asn.au
Web: http://www.anpc.asn.au

National Office Staff

Sue Mathams and Merryl Bradley

Volunteers

Odette Mayne and Liz Myszka

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Australasian Plant Conservation

Editor

Rosemary Purdie

Editorial Team

Paul Adam, Phil Ainsley, Tom Celebrezze, Adrian Fethers, Paul Gibson-Roy, Sally Jacka, Bob Makinson, Sue Mathams, Liz Myszka and Zoë Smith,

Layout & Graphic Design

Siobhan Duffy

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New Zealand Plant Conservation Network

President Philippa Crisp
Secretary John Sawyer
PO Box 5086 Wellington, New Zealand.
Email: info@nzpcn.org.nz
Web: www.nzpcn.org.nz

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Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. **The deadline for the December 2010–February 2011 issue is Friday 19 November 2010.** That issue will contain papers from the ANPC 8th National Conference. General articles are also very welcome. Please contact Rosemary Purdie if you are intending to submit an article: Rosemary.Purdie@environment.gov.au.

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Please send articles, no more than 1200 words, as a MS Word (2000 compatible) or rich text format file, on disk or by email to: Rosemary.Purdie@environment.gov.au.

Front cover: Stock route on the Darling Downs, Queensland, representing one of the last vestiges of the original grasslands. Photo: Queensland Herbarium.

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NSW Roadside Environment Committee

Sponsor

ANPC thanks the NSW Roadside Environment Committee for its sponsorship of this issue of *Australasian Plant Conservation*.

From the Editor

Rosemary Purdie

c/- Centre for Plant Biodiversity Research, Canberra.

The theme for this issue of *Australasian Plant Conservation* is 'Plant conservation and linear vegetation remnants'. These remnants are most prominent in agricultural areas as vestiges of native vegetation along roadsides, railway lines and other infrastructure easements, and have many co-existing values. In addition to the conservation value of their plants, they provide faunal habitat, often act as wildlife corridors and provide connectivity between larger areas of native vegetation, help protect waterways, and act as wind buffer zones. They provide visual amenity, recreational opportunities and may have a range of Aboriginal and non-Aboriginal cultural values. Those that are part of travelling stock routes allow for stock movement and provide refuge for livestock in times of drought. Many linear remnants are also areas used for fuel reduction burns or can become front-line areas in controlling unplanned fires.

Achieving plant conservation in linear remnants cannot be done in isolation from their multiple values, and the many threats the remnants face—inappropriate roadside and infrastructure corridor management, new developments, inappropriate grazing regimes, logging, firewood collection, illegal dumping, mining and weed invasion, to name but a few.

The articles in this issue take a deeper look at linear vegetation remnants, describing how they have arisen, why they are important, and the threats faced by the vegetation and species located in them. There are examples of who is managing them, and how they are being managed to protect or enhance their plant conservation values.

In his Guest Editorial, Peter Spooner traces the history of development of the road reserve and travelling stock reserve networks across Australia and their legacy of linear vegetation remnants. He highlights issues associated with management to maintain both their conservation and cultural values. While noting that much good work is being done, he also reminds us that the key threats to them require "constant vigilance", a theme that is reflected in most subsequent articles.

The articles commence with a group of five that focus on management aspects of linear vegetation remnants in New South Wales. Neil Dufty outlines the leading work of the state's Roadside Environment Committee; Josie Stokes and colleagues describe collaborative arrangements between different organisations in the South West Slopes; and Meredith Laing discusses an innovative roadside environment toolkit developed for use by local government in the Hunter region. James Doak describes his experience with bureaucracy to protect a linear remnant of coastal bushland and also highlights the value of cooperative efforts, while Bev Smiles and Adam Blakester discuss improved management needs of the travelling stock route network in the state, and an initiative for longer-term protection of these linear remnants across Australia.

We then take a closer look at the specific conservation value of linear remnants in five states. Rod Fensham summarises the values of the travelling stock reserve network in Queensland, while Bob Johnson and Bill McDonald describe the unique value of a linear remnant of Brigalow forest in that state. Stuart Johnston and Roger Good use the restoration of a transmission line easement in the Australian Alps to highlight how such corridors can contribute to biodiversity conservation within protected areas provided the restoration works are based on ecological principles and practices. Frank Carland and Natasha Kennedy also highlight the importance of restoration, in their case along road verges in the Western Region of Victoria, to assist the recovery of a threatened ecological community. Threatened ecological communities and/or species are also important features of roadside reserves and their management in Tasmania's Midlands, described by Louise Gilfedder, and in the south-west of Western Australia, described by Caron Macneall.

ANPC has received a grant from the NSW Environmental Trust to run a series of workshops on managing vegetation in the state's travelling stock reserves, as outlined in the article by ANPC Project Manager Sue Mathams. One objective of the project is to develop training materials that could be applied to the management of other linear remnants in New South Wales and in other states. The articles in this issue of *Australasian Plant Conservation* highlight the importance of appropriate management of linear vegetation remnants across Australia. If you would like to explore the opportunity for similar workshops in your area or state, please contact Sue—details are provided in her article.

The themed-articles are followed by three general papers. First, Bruce Wannan discusses how modelling based on geographic information systems has been used to locate populations of threatened endemic plants on Cape York Peninsula. Maria Matthes then outlines the importance of plant-insect interactions, highlights some books that help

amateurs identify insects, and makes a plea for people working with plants to pay more attention to this group of organisms. Recognising my own confusion with the changing world of plant families, in the third article I summarise some of the current changes and provide web links that help provide clarity.

The issue concludes with our regular features: Zoë Smith's report from the USA, Research Roundup; eight book reviews, Information Resources and Useful Websites, ANPC workshops, and Conferences.

It's a bumper spring issue for you to enjoy.

GUEST EDITORIAL
Conservation management of linear vegetation remnants in Australia

Dr Peter Spooner

Charles Sturt University, Albury, NSW. Email: pspooner@csu.edu.au

Roadside environments are a ubiquitous component of the Australian landscape. Within this vast network of corridors, remnants of native vegetation often provide the only remaining evidence of extensive forests, woodlands and grassland ecosystems which once graced the countryside. In conjunction with other transport corridors, roadsides often constitute a significant proportion of native vegetation remaining in agricultural or urbanized areas, and provide important refuge for populations of native plants, many of which are threatened or endangered. Australia is indeed fortunate to possess these linear remnants, but how did they get there?

The narrow area of land which contains the road and surrounding environments is a road reserve—an area of public land set aside to provide transportation routes, many of which were first surveyed in the late 19th century. As our landscapes were subdivided for settlement (mostly after Land Acts implemented in 1861), road reserves were also surveyed so all title holders could gain access to water. Most road reserves were originally surveyed at one chain (20.12 m) width, which was suitable for a horse and carriage of the times, but barely wide enough for modern transportation needs. Major trunk routes, rail reserves and stock routes were also surveyed at widths of 1.5–5 chains (30–60.3 m), depending on transport use at the time (Figure 1). The (indirect) legacy of these past land-use decisions is an extensive network of vegetated corridors traversing much of the developed areas of our country.

By the early 1900s, much of the 'road network' was nothing more than an ad-hoc collection of narrow vegetation corridors, where travellers navigated their way through the trees and mud, along rough bush tracks. Local councils had the enormous task of making this network trafficable, where individual road reserves that were required for transport use were declared as 'open' roads. Development of road networks continued throughout much of the early 1900s, which also resulted in decisions not to use many previously surveyed road reserves (known locally as 'paper roads', in reference to their existence as 'roads' on parish maps). Later, councils would close a number of unused road reserves, and these bush corridors provide enormous conservation opportunities (Figure 1). Unfortunately, a number of state governments have not realized these values, and sold off many over the years.

Stock routes are also an integral component of road networks in many states. Indeed, most of the general public would not know if they are travelling down a normal road or stock route. The clue is in the width of the corridor.

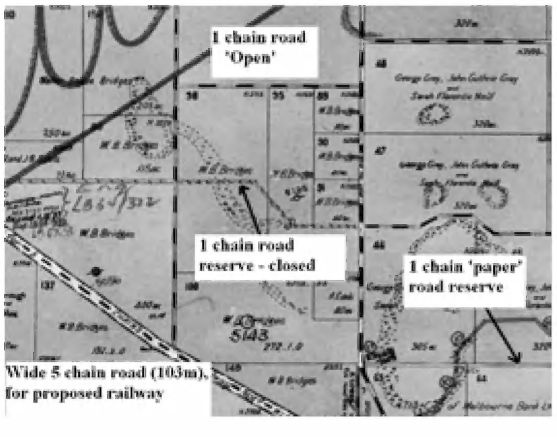

Figure 1. Parish map of Lowes (County of Hume), located north of Corowa, NSW showing a typical arrangement of land parcels and roads, as a result of land-use decisions in the late 1800s. Open (solid dashed lines), closed (diagonal hatch lines) and unused 'paper' road reserves are shown, which are the result of later council decisions to manage the road network. Source: NSW Land and Property Management Authority 2010.

Many stock routes were surveyed up to a half or one mile wide, however most are three chains (60.3 m) wide. These are our oldest roads, and were developed to link grazing lands to markets and other forage areas. Their development created our largest network of vegetated corridors which, by the late 1800s, was in the order of millions of hectares. Today, the network is much reduced, although many components still remain which possess significant conservation values.

Since the late 1980s, there has been increasing attention toward the conservation management of stock routes and other roadside environments. Rather than use a grader to remove roadside vegetation for safety concerns, more enlightened councils are now endeavouring to better manage these precious biodiversity assets. In the 1990s, bodies such as the NSW Roadside Environment Committee were formed to encourage the better management of the roadside environments, by providing training and assistance to identify the natural and cultural heritage values of roadsides. For example, most councils have used a rapid bio-assessment methodology of some kind to assess the conservation values of each road segment (ranked as High, Medium or Low). These rankings are then used to determine appropriate management actions for each road category, as described in local roadside management plans.

Efforts to maintain roadsides vary enormously from one council area to the next, which largely depends on available funding and other issues (e.g. see articles in *Australasian Plant Conservation* 18(3)). In many areas, rural councils cannot afford a dedicated environment officer, and so compliance to any roadside plan is often lacking. On this issue, roadside vegetation plans need to be promulgated in local by-laws for any compliance to take place, else they can languish as a dusty survey document in the engineer's office. Another issue is that training of council workers in the recognition of roadside conservation values is often lacking or non-existent, and local contract workers are often over-looked in the process. Ongoing training is necessary for workers to know exactly where the 'good bits' are, so as to avoid damage by heavy machinery. To this end, simple marking of roadsides (using colour-coded markers on existing road reflector posts) has been implemented in some council areas to warn road managers of sensitive vegetation areas.

It is critical for state-based natural resources agencies to provide further training and resources towards the conservation management of roadsides. Yes, councils are responsible for their management; but given that conservation outcomes derived from roadsides can greatly contribute to catchment- or state-based conservation targets, these assets cannot be ignored. Also, in terms of future climate change scenarios, we are fortunate to already have a 'green network' in place to assist native species to disperse across the landscape. In this context, it is vital that roadside vegetation networks are maintained and even improved with further restoration inputs. Vegetation conditions can improve or deteriorate, depending on prevailing disturbances (e.g. stock grazing, or soil disturbances from grading), edge effects, impacts from the surrounding farmlands, or internal roadway stressors. Therefore regular monitoring of conditions is highly desirable to refine management inputs.

Road reserves and stock routes also have many cultural heritage values to consider. For example, a number of our roads literally follow the tracks of our first explorers and settlers. Likewise, stock routes were developed by drovers, squatters, settlers and indigenous peoples, leaving an exciting historic narrative to recount. Indeed, a number of stock routes are thought to follow previous indigenous traditional pathways, so could be thousands of years old. As such, each road has a story to tell, which could be a useful approach in interpreting and educating the general public of broader roadside vegetation values.

It's important to note that the cultural heritage values of roads and stock routes are not just confined to physical structures or other historic evidence, but can be recognised for possessing uncommon, rare or endangered aspects of our natural history (e.g. rare or endangered plants or ecosystems). In turn, these species, habitats, and remnant ecosystems provide important aesthetic values, which are unique to this country.

Other more novel linear remnants demand equal attention. Railway reserves provide unique habitats for many key flora where, in many locations, past rail management activities (e.g. burning) have ensured the persistence of important grassland species. As a result, many local groups have taken the opportunity to develop closed rail reserves to better manage their natural and recreational values. Likewise, corridors created by utilities and powerlines can provide refuge for some plant species.

Local naturalist and Landcare groups, councils and larger state-base agencies often do a wonderful job in conserving the vegetation in road reserves, stock routes and rail reserves. However key threats such as grazing, invasive species and pollution from adjacent areas require constant vigilance. As human constructions, the key to success in ensuring the persistence of the roadside vegetation is in addressing the ongoing human threats, and better recognition of their conservation and cultural heritage values.

Leading practice in the environmental management of New South Wales linear reserves—the role of the NSW Roadside Environment Committee

Neil Dufty

NSW Roadside Environment Committee, Parramatta. Email: ndufty@molinostewart.com.au

Linear reserves in New South Wales (NSW) include roadsides, travelling stock reserves, rail corridors and infrastructure easements (e.g. for electricity lines, gas pipelines).

The roadsides of the approximately 180 000 km of public roads in NSW and the estimated 2.27 million hectares of the Travelling Stock Reserve network are each estimated to comprise about 3% of the State's land area. These, coupled with rail corridors and infrastructure easements, mean the total area of linear reserves is approximately 6.5% of the State (compared with 8% in NSW national parks and nature reserves).

Apart from covering a large area, the State's linear reserves contain significant native biodiversity, including ecological communities that are not protected in national parks, public reserves or private land. In rural areas, linear reserves also often constitute the only remaining intact natural environments in the district due to extensive clearing for broadacre farming and other land uses. Linear reserves additionally provide invaluable wildlife habitats and corridors, especially when linked with other native vegetation remnants in the landscape where they provide connectivity and may assist in addressing threats associated with climate change.

Linear reserves have many values and purposes including:

- transport routes (e.g. for stock);
- agistment during drought;
- fire control lines;
- carbon sinks;
- places of Indigenous culture and heritage;
- sites of historic heritage;
- aesthetic appeal;
- recreational opportunities; and
- research and educational sites.

The NSW Roadside Environment Committee

In recognition of these values, the NSW Government established the NSW Roadside Environment Committee (the Committee) in 1994 as an umbrella body to promote and coordinate leading practice in linear reserve environmental management across the State. The following organisations, including land managers, are currently represented on the Committee:

- NSW Roads and Traffic Authority;
- NSW Rural Fire Service;
- RailCorp;
- Country Energy;
- NSW Department of Environment, Climate Change and Water;
- Local Government and Shires Association of NSW;
- NSW Nature Conservation Council;
- NSW Land and Property Management Authority;
- Livestock Health and Pest Authorities;
- Institute of Public Works Engineering Australia; and
- NSW catchment management authorities.

The Committee meets on a quarterly basis including at rural and regional locations. Its operations are funded by the Roads and Traffic Authority with secretariat support services currently contracted to Molino Stewart Pty Ltd.

Members of the NSW Roadside Environment Committee inspect direct seed drilling activities. Photo: Josie Stokes

Since its inception in 1994, the Committee has actively worked on its charter. An initial phase involved researching leading practice in linear reserve environmental management. This research culminated in the production of several guides and fact sheets for the use of local councils and other linear reserve managers. For example, in 1996 the Committee produced a *Roadside Handbook* which provided environmental guidelines for road construction and maintenance workers.

From 2004–08, the Committee managed a large project grant from the NSW Environmental Trust to support local councils in assessing native vegetation

along their roads and producing roadside vegetation management plans. As a result of this project about two-thirds of local councils in the State now have these or similar plans. Since then, the Committee has concentrated on reviewing and consolidating work undertaken to support leading practice over the past 15 years.

A recurrent feature of the Committee has been its ability to partner and network with local councils and other stakeholders across NSW to encourage improved linear reserve management. For example, the Committee has supported several important stakeholder initiatives such as the roadside environment project developed by the Hunter Central Coast Regional Environmental Management Strategy. It distributes its electronic newsletter to over 150 stakeholder organisations to share ideas and research on linear reserve environmental management.

Further details about the Committee and its guidelines for assessment, planning, implementation, monitoring and evaluation can be found at the Committee website at <http://www.rta.nsw.gov.au/rec>

Issues and challenges

The Committee has developed and is implementing its strategic plan to help address several issues and challenges related to linear reserves and their management.

Balancing road safety with conservation

An ongoing issue for road managers is how to balance the requirements of road safety with the need to protect and conserve significant roadside native vegetation. The Committee commissioned consultants ARRB Group Ltd to research this issue. As a result, through its member organisation the Institute of Public Works Engineering Australia, it is currently trialling risk assessment spreadsheets that may assist local councils with this issue.

Fire management

Fire management is another important issue that linear reserve managers need to address. Linear reserves can present either potential ignition points for bushfires or can act as a control line and access for fire fighting. They also may require the application of appropriate fire regimes to conserve native biodiversity. Committee members are reviewing their approach to fire management in linear reserves, particularly in the light of the recommendations of the 2009 Victorian Bushfires Royal Commission report.

Weed and litter management

Other issues addressed in the Committee strategic plan include weed management and litter reduction programs. The Committee has also identified several challenges and included actions related to them in the plan. Inappropriate activities by infrastructure and reserve maintenance staff, such as excessive clearing, spraying, mowing and trimming in high conservation value areas, can lead to further degradation of linear reserve environments. To respond to this challenge, the Committee has supported the training of operational and maintenance staff in some local councils and is currently identifying new strategies to broaden this initiative.

Roadside vegetation management plans

The Committee recently surveyed NSW local councils to evaluate the extent of implementation of roadside vegetation management plans, with a view to improvement and filling any gaps. It is concerned that although many local councils had developed these plans, they were not being fully implemented. The Committee proposes to work with councils to support the review and implementation of the plans.

Communication

Another challenge is to effectively communicate leading practices in linear reserve environmental management to all stakeholders. The Committee's communication plan includes strategies to provide access to leading practice initiatives through the Committee website, electronic distribution of the Committee newsletter, encouraging professional networking and support for leading practice awards. The Committee encourages the use of Significant Roadside Environment Area signage to increase awareness of high conservation roadsides both with maintenance staff and the general public.

Conclusion

Significant progress has been made since 1994 in improving the management of linear reserves across NSW. An ongoing commitment from land and infrastructure managers and other stakeholders to use leading practices is required to continue this progress. The Committee will continue to promote the implementation of leading practices in linear reserve management through partnerships, education, research and support.

Example of a Significant Roadside Environment Area sign promoted by the NSW Roadside Environment Committee. Photo: Albury City Council.

Working collaboratively to restore connectivity in the South West Slopes bioregion of New South Wales

Josie Stokes[1], Elisa Tack[2], Sarah Stuart[3] and Kevin Roberts[1]

[1]Roads and Traffic Authority of NSW. Email: josie_stokes@rta.nsw.gov.au

[2]Murray Catchment Management Authority, Albury.

[3]Albury City Council.

Introduction

The South West Slopes is the most extensively cleared bioregion in New South Wales (NSW) (Benson 1999), with few formal conservation reserves (Pressey *et al.* 2000). It is estimated that 22% of the Murray catchment's woody native vegetation remains (Miles and Trust 2001).

In 2007, the Roads and Traffic Authority of NSW (RTA) received approval from the NSW Department of Planning to upgrade five sections of the Hume Highway, from the Sturt Highway junction, south to Albury. As part of upgrade project approvals, the RTA committed to developing a biodiversity offset strategy.

A reference group was established in July 2007 to provide advice on the development and implementation of the Offset Strategy and Package. It comprised members of NSW Department of Environment, Climate Change and Water, the federal Department of Environment, Water, Heritage and the Arts, the Murray and Murrumbidgee catchment management authorities, and the Hume Livestock Health and Pest Authority.

One of the main objectives of the reference group was to deliver an Offset Strategy for the project that would offset the residual impacts on biodiversity, particularly on Box-Gum Woodland and habitat for threatened species, so as to maintain or improve biodiversity values in the area in the long term.

The group's members began working collaboratively with a common goal of restoring connectivity in the South West Slopes bioregion. Collaborative activities included:

- delivery of the RTA Offset Strategy;
- revegetation by the Murray Catchment Management Authority; and
- assessment and signage of significant roadside vegetation by Albury City Council.

Delivery of the RTA Offset Strategy

The Offset Strategy was comprised of a hierarchy of offset measures including securing remnant native vegetation protection through conservation covenants, and strategic revegetation for threatened species and communities.

Securing remnant native vegetation

In order to deliver this offset measure, the RTA engaged the services of the Nature Conservation Trust of New South Wales (the Trust). The Trust is a non-government body set up under the *Nature Conservation Trust Act 2001* (NSW) to promote the conservation of natural and associated cultural heritage on private land in the state.

The Trust identified an area for delivering the remnant native vegetation offset component. The 100 ha property *Slate Hill*, near Woomargama, was selected and purchased by the Trust as the first offset site for the project (Figure 1). It contains Box-Gum Woodland and suitable habitat for the Squirrel Glider and threatened woodland birds including the Brown Treecreeper. Additionally, *Slate Hill* is adjacent to the 12 ha Blue Metal Travelling Stock Reserve that contributes to the long-term survival and recovery of local populations of Grey-crowned Babblers, Brown Treecreepers, Diamond Firetails and Squirrel Gliders.

The Trust is undertaking a program of works on the property aimed at increasing the quantity and quality of Box-Gum woodland and its value as habitat for the threatened birds and mammals. By completion of the Offset Package the RTA and the Trust will have protected and improved more than 630 ha of private land in the region containing Box-Gum Woodland.

Figure 1. Slate Hill *offset property, near Woomargama, NSW. Photo: Josie Stokes.*

Other offset measures

The RTA committed to various other biodiversity offset measures as part of the project to contribute to the long-term improvement of the new road corridor and to promote species movement and genetic variation. These included strategic revegetation, wildlife crossing treatments, installation of nest-boxes and implementation of a threatened species monitoring program.

To date, about 116.6 ha within the project area has been revegetated with plantings indicative of the Box-Gum Woodland vegetation community as part of the landscape and revegetation works.

Revegetation by the Murray Catchment Management Authority

As a result of over-clearing of private land for agricultural and pastoral practices, linear reserves in the South West Slopes bioregion (including roadside and travelling stock reserves) are an important resource for biodiversity. They also provide important corridors and stepping stones between large areas of natural vegetation (e.g. national parks and state forests), facilitating the movement of animals and plants across the landscape. A recent study has shown that travelling stock reserves (TSRs) tend to support more species of declining birds and a greater abundance of arboreal mammals than woodland remnants on private land (Lindenmayer *et al.* 2010).

The Murray Catchment Management Authority (CMA) is committed to the conservation of the Murray Catchment's valuable linear reserves, including road reserves and travelling stock reserves. The RTA provided funding to the CMA for its Seed Production Area, and the CMA has been active in helping to improve the *Slate Hill* offset property by its vegetation services team undertaking revegetation there through direct seeding of trees and understorey shrubs (Figure 2).

Additionally, neighbouring landholders to *Slate Hill* and Blue Metal TSR have received funding from the Murray CMA for the enhancement and protection of biodiversity on their properties to further extend and improve the remnant vegetation in the landscape. This will lead to an increase in structural connectivity within the region, not only providing additional habitat, but also facilitating dispersal movements and gene flow within discrete patches of habitat.

The Murray CMA believes that the partnership with landholders and agencies on this project is a great example of how working collaboratively can achieve a broad range of objectives, and provide a positive outcome for biodiversity within the region.

Assessment and signage of significant roadside vegetation by Albury City Council

Albury City Council recently produced the guiding document *Native Vegetation Plan for Roadsides, Waterways and Council Controlled land in the City of Albury*. It identified and assessed areas of land and rated them of high, medium or low conservation value using a rapid assessment process. As a result, maps highlighting vegetation conservation values and a prioritised works program were developed.

Out of 212 km of non-urban roadsides surveyed, 8% of areas were considered to be of high conservation value and 10% of medium conservation value. All areas with either of these two ratings were signposted with the NSW Roadside Environment Committee/Albury City 'Significant Roadside Environment' signage. The purpose was to raise awareness in the community and prevent damage to significant areas from residents, work crews, and council staff or contractors.

Another objective of the project was to maintain the areas of high conservation value and improve those of medium conservation value to a high rating through weed management, revegetation, direct seeding and the minimisation and prevention of disturbance.

Figure 2. Murray Catchment Management Authority direct seeding machine in operation at Slate Hill. Photo: Josie Stokes.

Conclusions

These three projects shared the objective of improving the management of high conservation value vegetation in linear reserves within the South West Slopes bioregion.

The construction of the Hume Highway Upgrade has resulted in new conservation areas that link with other linear reserves such as the travelling stock reserve network, which will be actively managed by the Murray CMA.

The revegetation work undertaken on *Slate Hill* by the Murray CMA provides information on new techniques for improving the extent and condition of Box-Gum Woodland. The outcomes of the Albury City Council roadside vegetation project guide the ongoing maintenance and monitoring of high conservation areas into the future.

While the key drivers for each project were different, by working in a collaborative manner, the outcomes were better targeted and will provide a longer lasting legacy for biodiversity within the region.

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Call for plant stories for new Jane Goodall book

Dr Jane Goodall is renowned for her work studying chimpanzees in the wild. This has led her to active promotion of animal conservation around the world through speaking tours (see Jane Goodall Institute website www.janegoodall.org), and through books like her 2009 *Hope for Animals and Their World: How Endangered Species Are Being Rescued from the Brink* (Grand Central Publishing).

But Jane is also interested in supporting and promoting plant conservation, and is working on a new book devoted to it. Jane is calling for stories from plant conservationists around the world, about "plants being rescued from the brink of extinction, or conservation successes in plant breeding, worthy of consideration for this new publication".

Jane's collaborator Gail Hudson writes "We want stories that involve the saving and/or restoring endangered plants, trees, grasses, etc, and even sea plants. We would like stories to have a human interest angle, for instance a plant being rescued because of its sentimental or historical significance, or people risking their lives to save plants—a little human drama. We want stories that involve endangered indigenous medicinal or wild food plants. We want stories that involve people planting plants in order to restore an entire ecosystems or habitat for other endangered animals, insects, etc. We like stories that involve citizen and/or children participation—not just botanists (although we love botanists!)".

Jane and Gail will be accepting and researching new story leads through January of 2011. If you have a case study that you think would work for this book, send a precis (of no more than 1,000 words) to <g.hudson@cablespeed.com> by 15 January 2011. It doesn't have to be a formal document—just a casual summary of the project. Please include a phone number and email where the authors can contact you if they have follow-up questions.

Grazing cattle in a Travelling Stock Reserve on the Western Slopes of New South Wales. Photo: Rosemary Purdie.

Remnant vegetation along a roadside verge in the wheat-belt of south-west Western Australia. Photo: Murray Fagg.

An innovative Regional Roadside Environment Toolkit

Meredith Laing

Environment Division, Hunter Councils, Thornton, NSW. Email: envirodirector@huntercouncils.com.au

The Hunter and Central Coast Regional Environmental Strategy (the Strategy) is a framework under which councils have worked collaboratively on environmental and sustainability issues at a regional scale since 1996.

Over the last four years the Strategy team has designed and developed an innovative Regional Roadside Environmental Management Toolkit which aims to improve the protection and management of roadside environments in order to sustain and enhance the ecosystem services and environmental values they provide. This is to be achieved whilst continuing to provide safe, efficient and well maintained transport, communication and utility corridors for the community.

Unlike most other roadside projects around Australia, this initiative goes well beyond focussing on the signage and protection of remnant vegetation in linear reserves. It effectively addresses the whole range of key natural resource/cultural/economic issues commonly affected by roads and their management.

Issues that shaped the Toolkit

A wide range of ecological values in roadside environments need better protection. Research showed that roads in the region interact with a diverse range of environments including those recognised as ecologically significant under the national *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Act 1995* (NSW). Roadside environments in the region directly adjoin 480 km^2 of Ramsar listed wetlands, and are home to at least 28 threatened flora species. At a local level, roadside environments often contain the last remaining remnant vegetation in areas where substantial clearing has been undertaken for agricultural, industrial or residential purposes. Roadside vegetation can often provide important linkages for wildlife corridors, protection for waterways and act as essential buffer zones for strong wind, soil erosion/dust and noise. Despite this, roadside environments and values are typically vulnerable to degradation due to their inherent exposure to high levels of disturbance.

Other issues were the range of social/cultural values inherent in roadside environments, such as Aboriginal and non-Aboriginal heritage, points of visual amenity and community recreation zones, and economic values including the provision of refuge for livestock in times of drought, and reducing wind and the evaporation of crops and pastures.

Councils and other authorities responsible for roadside environments face common management challenges. These include lack of clarity of road reserve tenure, lack of clear corporate-wide objectives and frameworks for a coordinated consideration of roadsides, and a lack of guidelines for roadside maintenance and rehabilitation for a variety of issues. There is often conflict between ecological management objectives and the need to provide adequate road safety standards. Degradation due to weed invasion, livestock grazing, inappropriate roadside mowing practices, bush fire hazard reduction, illegal clearing and burning, and illegal dumping are also a challenge, as are the broader impacts of drainage and runoff on waterway and catchment health. It is also extremely difficult for road maintenance workers to be aware of the environmental values or issues pertaining to many sites without a field guide or other information.

Project activities

In order to meet the aims of the project, and to address many of the challenges facing road managers, the Strategy team set about developing a comprehensive toolkit of policy, planning and technical tools and decision support mechanisms. They did this by:

- mapping the region's roads and categorising them in relation to tenure, management responsibility, type and status (sealed, unsealed);
- auditing, collating, data-basing and mapping all existing information to assist in the identification of roadside environment values and management issues;
- surveying (both rapid and systematic), assessing and mapping high quality/priority areas for biodiversity conservation, environmental protection and improved management;
- designing and developing technical management guidelines for each key roadside management issue;
- designing and developing training programs for outdoor staff and managers responsible for roadside maintenance that will include key result areas for staff as part of their regular training updates;
- designing a roadside marker system and field guides linked to mapping and management guidelines; and
- designing and developing a regional monitoring and reporting program centrally managed and annually reported on by Hunter councils.

What was delivered?

A key product of the project was a Model Regional Roadside Environment Policy developed to establish a formal commitment by councils to adopting a coordinated framework for the protection, management and remediation of roadsides. Other products related to accessing and managing data and providing guidelines to minimise adverse environmental impacts.

GIS mapping tool

A comprehensive Roadside Environment Geographic Information System (GIS) mapping tool assists councils in better accessing and utilising GIS data when planning roadside maintenance and construction activities. The tool was developed by first constructing a detailed map that identifies all roads under the care and control of council, and classifies them according to tenure, management responsibility, status and type.

In addition, through desktop research the Strategy team collated all available data relating to environmental, social and cultural issues relevant to roadsides. These included known threatened ecological communities, threatened species, significant vegetation and habitat locations, and where roads intersect or are directly adjacent to world heritage areas, national parks, areas of ecological or cultural significance, wildlife corridors or water bodies. Acid sulphate soils, salinity and erodible soils were identified, as were sites of Aboriginal and European heritage.

This body of knowledge was added to by the records of local roadside environmental factors obtained from the rapid roadside assessment program undertaken across 2500 km of road. These factors included hydrology and drainage, erosion and sedimentation, salinity and acid-sulfate soil indicators, vegetation condition and structure, fauna habitat attributes, anthropogenic disturbance, and social and cultural heritage.

The GIS tool also incorporates data from systematic site surveys undertaken on behalf of the NSW Roadside Environment Committee, and several Rural Lands Protection Board offices at a range of known, iconic sites throughout the region. These now also form the basis of a long-term roadside monitoring program.

The completed GIS tool allows each segment of a road to be queried as to the environmental, legislative, safety and operational issues that have been identified within it.

Review of Environmental Factors template

The body of information collected is being incorporated into a comprehensive PC-based *Review of Environmental Factors* template. This will make it easier (and automated) for council staff to accurately and comprehensively complete these assessments for common road maintenance activities, and ensure their rigour, comprehensiveness, accuracy and legislative compliance. Importantly, linking the template to the GIS tool also helps ensure that sites containing significant values are appropriately identified and managed, and not inadvertently damaged, by roadside activities.

A range of environmental, social and cultural factors are contained in the GIS-mapping tool for 2500 km of roads in the Hunter region. Photo: HCCREMS 2009.

Technical guidelines

Detailed technical guidelines were produced addressing 17 different natural resource management issues and the protection and mitigation of the potential impacts of road management practices on the landscape. The guides assist road managers with the protection and enhancement of roadside environment values as part of their day-to-day road management activities. Councils now have guidelines for reducing impacts on waterways, threatened flora, wetlands, protected areas, and native fauna. Other guidelines relate to managing salinity hazards, acid-sulphate soil hazards, roadside grazing, and erosion and sedimentation during construction and maintenance. Protecting and re-establishing roadside vegetation during construction and maintenance, and environmental law and roadsides also have specific guidelines.

Roadside markers

The regional roadside marker system, approved by the Roads and Traffic Authority, has complemented the regional toolkit in the last 12 months. When fully implemented along the region's roadways, the marker system will indicate the location of all the mapped issues and values, and which of the 17 guidelines need to be applied when maintaining that section of the road. A laminated pocket Field Guide for roadside operational crews based on each of the technical guidelines and linked (colour coded) to the roadside marker system is currently being developed.

Training manual

A comprehensive Training Resource Manual has been developed for staff on the key environmental issues relevant to roadside environments and the use and application of the toolkit.

Conclusion

The Regional Roadside Environment Toolkit is able to be used by any council in New South Wales, and with some legislative adaptation, any council in Australia.

Saving the Gerroa Bushland

James R. Doak

Seven Mile Beach Landcare Group, Gerroa, NSW. Email: doak@zip.com.au

Gerroa is a small village within the Municipality of Kiama, on the south coast of New South Wales (NSW), about 130 km south of Sydney. The Gerroa Bushland consists of a 34 ha linear remnant between Seven Mile Beach National Park and the Crooked River. It contains a camping ground, a partially restored garbage dump and an old cess pit site. It is all Crown Land and is managed by Kiama Municipal Council under a trust deed.

This area is typical dune country of the coastal zone of NSW. The fore-dune carries grasses and acacia thickets. The mid-dune has Coastal Tea Tree (*Leptospermum laevigatum*) in dense thickets, which provide a salt-tolerant screen to the vegetation behind. The hind-dune is Open Banksia Woodland, which is quite degraded in places, plus Open Eucalypt Forest, where the main canopy species is Bangalay (*Eucalyptus botryoides*). There is a sub-canopy of Littoral Rainforest elements, including Cheese Tree (*Glochidion ferdinandi*), Guioa (*Guioa semiglauca*) and Lilly Pilly (*Syzygium* spp). The understorey contains *Lomandra longifolia*, Orange Thorn (*Pittosporum multiflorum*) and many other species. The Littoral Rainforest environment is listed as an Endangered Ecological Community.

*Asparagus Fern (*Asparagus aethiopicus*) smothering the ground below native trees, and preventing replacement of the canopy species. Photo: James Doak.*

The problem

The Bushland is seriously infested with weeds, light in the south, but massive in the north where the camping ground is located. The main weed species are Madeira Vine (*Anredera cordifolia*), Moth Vine (*Araujia sericifera*), Bitou Bush (*Chrysanthemoides monilifera*), Lantana (*Lantana camara*), Green Cestrum (*Cestrum parqui*) and most importantly, Asparagus Fern (*Asparagus aethiopicus*).

Asparagus Fern forms dense carpets, particularly in the north. It is hardy and invasive, and smothers and chemically inhibits other plants. It is resistant to chemicals and is very labour intensive to grub out, as the crown must be completely removed. Where it forms 'meadows' nothing else grows, hence there is progressive loss of canopy. It produces prolific berries which are spread by wind and animals.

Attempts at remediation

Various volunteer groups tried remediation over the years, with small support from Council. Asparagus Fern was hand-weeded in places and some replanting of native species carried out, with little success. In this dune environment, new plantings have a struggle to get established unless they are regularly tended. In dry weather periods, loss of stock is enormous. The Asparagus Fern infestations are beyond any volunteer group and frustration is inevitable, as the weed quickly springs up again during the growing season, spreading back into cleared areas.

A manager gets involved

I have a science background, am a retired Company Director and latterly, a self-employed consultant, and moved to Gerroa in 2000. I knew Asparagus Fern from my garden in Sydney, but otherwise was quite uninformed about bush matters. I was shocked at what I saw in this area and decided to do something about it. My initial enquiries were made to the Seven Mile Beach National Park rangers, who informed me that it was Council's responsibility, and made a plea to get something done, as the infestation was a threat to their park.

Through my local community association, I enquired of the Council. A manager came to the site and told me that they had 'no resources, no labour, no expertise and no funds' to do anything. He suggested that if I got some volunteers to clear the weeds, the Council would give me some trees to plant. I spent a few months, with the help of a Dunecare group from a neighbouring town, learning the utter futility of that approach.

Thinking laterally

In 2006 I went for a walk in the National Park and as usual, found no weeds. My manager's mind began to work and I thought, 'it's the same environment, how come?' I went back to our poor, degraded bushland and an idea formed. Why not add this to the National Park? They know how to look after it and they have some access to money.

Council were, predictably, very much in favour of my idea. I then approached our State Member seeking his support and quickly found myself in the press and on local TV. The idea rumbled on for about six months, then to my surprise, two groups demurred. Firstly National Parks, who said they would only want the good bits (i.e. without weeds), then Crown Lands, who were quite upset. Although I didn't realise it then, this was the turning point of my quest to save the Gerroa Bushland.

An unexpected twist

Crown Lands contacted me and asked why I was trying to give away part of the National Heritage. I suggested that they might like to have a look at how this part of it was faring. A day or so later a representative came to Gerroa and I took him for a walk. He was taken aback by what he saw and realised that the Management under Trust, which his organisation depended upon, was not working

About a week later, the then Minister for Lands, Tony Kelly visited the site and after promising that our National Heritage would be saved, said that $10 000 would be made available to get things moving. I was assured that the management problems, which had lead to this situation, would be fixed.

Young native trees planted in an area cleared of weeds. The dead Asparagus Fern in the foreground shows that it can be killed by spraying. Photo: James Doak.

Getting started on restoration

Protracted negotiations with Council began. Meanwhile Crown Lands helped me, working with a small, informal group of people, to get started on the restoration. We received funding from Crown Lands, Kiama Council and the Southern Rivers Catchment Management Authority, a major supporter who provided about $30 000. Then, through my Lions Club, I successfully applied for a 'Caring for Our Country Community Coastcare' grant in 2008 and received $45 000. In total we raised $95 000 over a two year period.

We could then employ a professional Bush Restoration company. They carried out a full survey of the site, identified all species and wrote up a Bush Regeneration Plan. They did extensive weeding and spraying, effectively removing many weeds. Importantly, they conducted several spraying trials on Asparagus Fern and found a combination that can kill it at certain periods in its growth cycle.

Later we formed the Seven Mile Beach Landcare Group and now meet every month to weed, plant and tend. In particular we have taken over the old cess pit area, which was a large open space covered in Asparagus Fern and other weeds. It has been freed from weeds and about 2000 trees planted. We have installed a 2000 litre water tank on the site, so our survival rates have been high.

The management outcomes

Crown Lands carried out a detailed study of their relationship with Council. I understand that the responsibilities arising from the Trust Deed were fully canvassed and several options suggested for the future. An important issue here was that a large amount of revenue is generated upon the subject land from the camping ground and other commercial activities. It seems reasonable to those of us who care for the land, that some of this be spent for its preservation.

Council has now accepted full responsibility for their Trust Deed lands. They have appointed a manager to oversee the three Crown reserves in the municipality. They successfully applied for a 'Caring For Our Coasts' grant of $40 000 and allocated another $30 000 in this year's budget. Now there are funds for a further year of professional work.

Conclusion

Bushland conservation is all about money in the end, so the ongoing challenge is to ensure that funds are made available. But we now have an active Landcare group which, backed up by the professionals, is having an impact.

This project is a good example of cooperative effort between diverse community stakeholders to preserve the natural environment. Sometimes, however, a walk in the bush can clear your head but may lead you down paths you never expected!

The campaign to protect travelling stock routes

Bev Smiles[1] and Adam Blakester[2]

[1]National Parks Association of NSW, Sydney.

[2]The Grass Routes, Invergowrie, NSW. Email: adam@paradigmplay.net

The National Parks Association of New South Wales (NSW) has been working for many years to highlight and protect the significant conservation values and landscape linkages provided by the Travelling Stock Route (TSR) network across the state. TSRs form important corridors and stepping-stones across the heavily cleared wheat-sheep belt of the state's Central Division, and also form a network connecting the wetter regions of the Eastern Division across the Great Dividing Range with the arid areas in the Western Division.

The history of TSRs dates back to pre-European settlement. They were often developed alongside or over pre-contact Aboriginal travel and song lines that allowed for travelling between reliable water sources. The early European settlers sometimes used Aboriginal guides through unknown territory. Hence, some traditional camping places became gazetted as travelling stock reserves.

The TSR network in New South Wales

Because the TSR network often follows water courses and easy routes across the landscape, they generally occur on fertile valley floors where food sources were abundant. This contrasts with most areas reserved in national parks for conservation purposes, that are on the rocky outcrops in the landscape that were too difficult to develop for grazing or cropping industries.

Conservation values

The remnant vegetation on TSRs on the fertile and highly productive soils provides key habitat and refuge for a suite of rare or threatened species and ecological communities, including many listed as nationally threatened under the *Environment Protection and Biodiversity Conservation Act 1999*. These include at least nine Endangered or Critically Endangered ecological communities, at least 14 Endangered or Vulnerable flora species, and at least eight Endangered or Vulnerable fauna species, including woodland birds, bats and reptiles. The TSRs also provide opportunities for species movement across the landscape, including those that are more common.

Current management

The management of the TSR network in the state is complex, and has seen a number of major restructures of the responsible organisations and government agencies.

The TSR land tenure is Crown Reserve under the state *Crown Lands Act 1989* which is administered by the Minister for Lands. The NSW Department of Lands is now the Lands & Property Management Authority.

Responsibility for managing the TSR network is with the Livestock Health and Pest Authorities (formerly Rural Lands Protection Boards), under the *Rural Lands Protection Amendment Act 2008.* This legislation is administered by the Minister for Industry and Investment as part of the Agriculture portfolio. These authorities manage the permits for travelling stock, leasing of reserves, maintenance of fencing, water access and some weed control. Landowners in each Livestock Health and Pest Authority district are rated to cover the services provided, including animal disease and pest control.

A key issue and challenge now facing the TSR network is the requirement for the new Livestock Health and Pest Authorities to develop business plans that identify the parts of the TSR network in their district that are uneconomic. These will be ceded back to the Lands & Property Management Authority. The latter has developed a pilot assessment methodology, tested in the Hunter region and a small area in the Central West, to consider the values of all TSRs ceded back. The pilot methodology has now been completed and is to be used across the state; it is available on the website <www.lands.nsw.gov.au/crown_lands/crown_reserves/stock_reserves>.

Future management

The National Parks Association of NSW has a major concern with the TSR network being broken up across a range of different land managers. One of the key concerns with a large hand back to the Lands & Property Management Authority is the possibility of the land then being sold off to neighbours. Nearer to towns, the land is highly likely to be sold to developers.

The possibility of increased grazing pressures to improve economic returns to each Livestock Health and Pest Authority or the sale of TSR land are major threats to the TSR network. Other threats include industrial scale logging operations, firewood collection, road widening, major infrastructure development (e.g. gas pipelines, broadband, power lines), mining and the uncontrolled spread of weeds such as Coolatai Grass (*Hyparrhenia hirta*).

The TSR network needs a set of overarching and consistent management principles across the state to protect its significant conservation values while allowing suitable uses to continue. Adequate resourcing for good management is also required.

The Grass Routes initiative—a national network

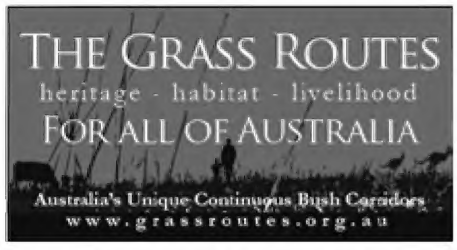
The value of an intact, well managed network of remnant vegetation that assists species movement across the landscape is an asset worth far more than the sum of its parts. The TSR network in New South Wales joins up with the Stock Routes Network of Queensland and is part of a continental scale connection across the eastern section of Australia.

From an economic viewpoint, the intact TSR network can be, and arguably needs to be, sustained by a wider range of income than grazing and travelling stock alone. There are many examples already of TSRs being shared and sustainably used for environmental and culture based tourism and outdoor education, etc. At the same time TSRs can provide a broader range of environmental services such as shelter belts and biodiversity arks.

TSRs are a vital piece of environmental infrastructure—Australia's biodiversity highway—that needs to be kept intact, maintained, enhanced and greatly expanded upon. There is an opportunity, if not a necessity, to conserve, build upon and link up the New South Wales TSR network with other travelling stock routes and landscape scale corridors across Australia.

The National Parks Association of NSW is a founding member of a new and growing network that is working to create a globally unique Australia-wide network of bush corridors, known as *The Grass Routes* initiative. These 'grass routes' are essential to protecting Aboriginal and European heritage and native habitats, as well as providing areas for sustainable livelihoods. The Grass Routes involves individuals, organisations, businesses, scientists, drovers and more, collaborating for the conservation, regeneration and sustainable shared use of Australia's unique bush corridors.

Determining the principles for shared and sustainable usage of TSRs and bush corridors is a priority. For instance, there is a growing body of evidence identifying that the major environmental changes and challenges now upon us



Sticker for The Grass Routes *initiative that is aimed at developing a national network of bush corridors.*

cannot be addressed by simply reserving land to preserve biodiversity. Rather, active regenerative management and working of the landscape can increase biodiversity values while conserving heritage and providing for livelihoods at the same time—making shared use corridors (including TSRs) an important outdoor classroom of national and global importance.

A further benefit of such shared principles will be to enable landscapes from the widest possible range of ownership structures—private, government, business and philanthropic—to be linked with existing corridors.

Conclusion

The vision for a nation-wide network of bush corridors is far from a flight of fancy. We still have an extensive network of TSRs, from the Canning in Western Australia to Klori in New South Wales. There is a growing list of landscape-scale corridors, including the Great Eastern Ranges, Trans Australia Eco-Link and Gondwana Link, and substantial private conservation corridors, such as Citizens Wildlife Corridors.

We need your help to create a truly Australian grass routes movement, protect and build upon the New South Wales travelling stock routes to create a nation-wide network of bush corridors. Go to www.grassroutes.org.au to join and find out more, particularly our innovative Kangaroo Grass Seed Pack to help raise much needed funds and awareness.

*Left: Klori Travelling Stock Route, NSW supports threatened White Box (*Eucalyptus albens*) grassy woodland. Photo: Nell Chaffey. Right: Travelling Stock Route near Parkes, NSW supports threatened Grey Box (*Eucalyptus microcarpa*) grassy woodland. Photo: Tom Widdup.*

Havens and oases—the conservation value of stock routes in Queensland

Rod Fensham

Queensland Herbarium, Brisbane. Email: rod.fensham@derm.qld.gov.au

The land surveys that carve up the Australian landscape into blocks of tenure provide a continuous network of corridors originally intended for transporting stock from paddock to market. Some of these 'stock routes' followed the most expedient tracks across the landscape that had already been established by Aboriginal people. Many have been converted to roads, and are now also utilised as corridors for the underground transport of electricity, gas, water and the ever-expanding broad-band network. Amidst this network of utilities, their original purpose for moving animals on foot has been almost forgotten. They are still used by the pastoral industry but more as 'long-paddocks' called upon during droughts to yield the last vestiges of pasture.

Across Australia, stock-routes are well known as important havens for nature conservation, and this is no less the case in Queensland. In heavily fragmented landscapes the stock routes preserve some of the only natural remnants of the original vegetation. On the Darling Downs in southern Queensland, natural grasslands on rich alluvial soils have been converted to highly productive fields of cotton and sorghum. The remaining 1% of the grasslands are mostly along the stock routes lining the main highways through the district.

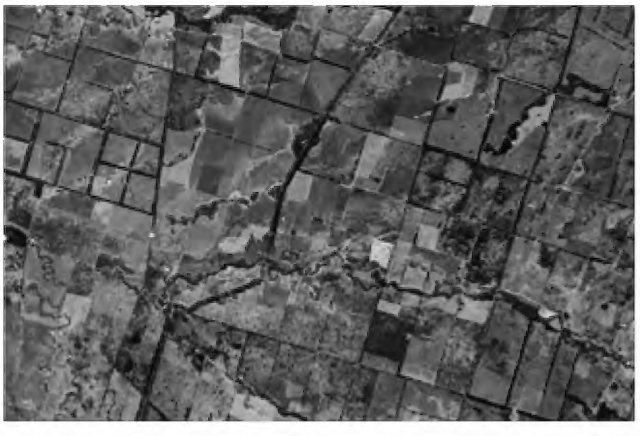


Figure 1. Aerial photo showing stock routes of Brigalow forest (dark stripes along roads) in the heavily fragmented landscapes of southern Queensland.

Past management

By their very nature, stock routes have a long history of grazing, but it is a very different style of grazing from that which occurs in the adjacent paddocks. During the first century of pastoralism, the stock routes would have been occasionally trampled to dust by large mobs of travelling stock. It is this heavy but sporadic grazing that is the hallmark of their management history. This allows the vegetation to recover and set seed, unlike in the continuously grazed paddocks. Stock routes in some areas also tend to have a history of regular burning.

Threatened ecological communities

A drive along stock routes preserving precious fragments of Brigalow forest (Figure 1), a curious scrubby vegetation type dominated by the silvery-leaved *Acacia harpophylla*, can give a false impression of the overall landscape. In the space of 50 years the Brigalow has been decimated, and the narrow stands of Brigalow provide a silver and green veil hiding cleared paddocks. The stock routes represent some of the last stands, particularly in the higher rainfall districts with the most arable soils. Unfortunately these last standing corridors have been invaded by exotic grasses making them vulnerable to fire that begins a vicious cycle driven by damaged canopies that allow for the growth of more grass and then ever-more fire.

Sometimes the stock routes border town commons, set aside as public land for various uses. Although often heavily grazed, these reserves are usually uncleared and so preserve important remnants of vegetation types that occupy more fertile land types, and have been largely obliterated in the district, such as Brigalow forest and Coolibah (*Eucalyptus coolibah*) woodland. The town commons at Yelarbon and Taroom are fine examples.

Rare plants

There are many rare plants that are largely restricted to fenced stock routes, including a suite of daisies that poke their large heads above the grass. Australia's only native thistle (*Stemmacantha australis*), the Belyando cobbler's peg (*Trioncinia retroflexa*) and others too rare to have common names (*Cymbonotus maidenii* (Figure 2), *Rutidosis lanata* and *Senecio daltonii*) are examples. Presumably such prominent and attractive plants are irresistible for cows and sheep and in the paddocks they are chewed to extinction. These plants seem to thrive on the disturbance of occasional grazing, and proliferate with fire.

An undescribed solanum (*Solanum* sp.) is one of Australia's rarest plants, and is known from a single small population on a stock route near the town of Clermont. We have no record of its flowers or fruits, but its leaves are the size of dinner plates and unlike any other species. The herbarium labels on the historical collections suggest this plant can behave like a weed immediately after ploughing but cannot persist amidst crops and repeated cultivation. The plant does not seem to cope well without some form of disturbance, and has not been seen amongst the native grasses at the site for several years. It has underground stems and is expected to bounce back following the next fire.

Natural springs

Across the great expanses of western Queensland, the stock routes criss-cross intact landscapes. They are not fenced and you need a map to know where they are. However, the surveyors were instructed to position their course to provide links between reliable water so that stock could get a regular drink. Often they follow streams and pass beautiful Coolibah-lined waterholes.

Stock routes and watering reserves contain some of the most significant natural springs in Queensland. These tiny island oases (Figure 3) in an otherwise parched landscape are fed by the Great Artesian Basin. The community of native species dependent on the natural discharge of groundwater from the Great Artesian Basin is also a threatened ecological community. Biologists are still coming to understand the unique animals and plants living within these permanent wetlands. The major threat to the springs is the hundreds of bores that gush groundwater down open streams and rob the springs of their flows. A bore capping scheme is underway to alleviate this profligate waste, and the presence of the springs on public land should allow them to be better recognised and valued.

The future

Now that trucking has become the normal mode of transport, stock routes are no longer as vital to the grazing industry, and the imperative to manage them as a public resource has diminished. These vast areas of land do require maintenance, including fencing and fire management, and government bodies seem keen to pass on the responsibility.

Surveys of the biological values and condition of stock routes for nature conservation have been conducted but must be completed before rational decisions about their future can be made. Perhaps they should be given a new status as conservation reserves, with management prescription that should include occasional grazing and regular burning as has happened in the past. Some, such as the strips of Brigalow, have high conservation values, but will need active management if they are to survive.

Figure 2. The rare daisy Cymbonotus maidenii *growing between a roadside and cultivated paddock in the Darling Downs. Photo: Queensland Herbarium.*

Figure 3. Mound spring in a stock route near Eulo. Photo: Rod Fensham.

The Brigalow Reference Area—a unique linear remnant

R.W. Johnson and W.J.F. McDonald

Queensland Herbarium, Toowong, Qld. Email: bill.mcdonald@derm.qld.gov.au

Introduction

Brigalow (*Acacia harpophylla*) woodlands and open forests at the time of European settlement occupied approximately 7 million ha, extending from northern New South Wales to about Charters Towers in Queensland. They found their best expression in the 500-750 mm rainfall belt on relatively fertile cracking and non-cracking clays and texture contrast soils with a shallow A horizon (Johnson 1964). With closer settlement and the expansion of agricultural and pastoral industries these communities were cleared and replaced by pastures and crops (Johnson 1964). Following World War II and the introduction of heavy machinery the rate of clearing accelerated and it is now estimated that approximately 86% of the original communities have been cleared (Johnson and McDonald 2005).

The Brigalow Research Station, 32 km north-west of Theodore, was established in 1963. It was set up to study problems associated with the development and utilisation of the brigalow lands and to gain a better understanding of their natural variation and long-term changes in factors affecting productivity. It has an altitude of approximately 150 m and an average annual rainfall of approximately 700 mm.

The vegetation (Johnson 2004) and soils (Webb 1970) were described and mapped prior to large scale clearing and a reference area was fenced off. This area was designed to benchmark the initial environment and to provide a comparison with changes that followed the agricultural and pastoral developments on the Station. It also provided an opportunity to monitor the impact of climate change on an area of conserved vegetation

Methods

The reference area is a narrow strip of the original vegetation approximately 6.5 km long and 400 m wide along the northern boundary of the Research Station (Figure 1). The eastern section of the reference area is the site of a monitoring project to assess long-term changes in vegetation resulting from changes in climate. This block, approximately 3.7 km long and 400 m wide, was fenced to exclude domestic grazing animals and also protected from fire. It covers a range of vegetation communities from a narrow levee in the west along Roundstone Creek at right angles to the general topography of the area. A transect bisecting the reference area and comprising 182 contiguous plots each 20 m x 20 m was permanently marked. In each plot, data were collected on density, cover and frequency of all species and basal area and height of all woody individuals (Johnson 1980).

Initial recordings were made in the late 1960s and the original vegetation was described and related to environmental variables (Johnson 1980). In 1990 every tenth plot, and in 1992 an additional 12 plots containing semi-evergreen vine thicket (SEVT) vegetation and associated Brigalow, were re-measured. In 2005 all plots were remeasured except for the 12 SEVT plots measured in 1992.

Results

Though the reference area adjoins extensive paddocks of improved pastures and areas of disturbance, no significant invasion of exotic species has occurred in almost 50 years. Occasional plants of exotic species such as Parthenium (*Parthenium hysterophorus*), Green Panic (*Megathyrsus maximus* subsp. *pubiglumis*) and Buffel Grass (*Pennisetum ciliaris*) have established, but they have not persisted to form threatening populations. This is mainly due to the resilience of the native vegetation and protection from fire and grazing animals.

However the vegetation originally conserved has changed considerably over that 50-year period. Johnson (1980) recorded six plant communities from the reference area separated by narrow ecotonal vegetation. The communities were:

- Bonewood (*Macropteranthes leichhardtii*)—semi-evergreen vine thicket,
- Brigalow (*Acacia harpophylla*)—semi-evergreen vine thicket,
- Brigalow continuum (clay soils) (Figure 2),
- Brigalow continuum (duplex soils),
- Blue Grass (*Dichanthium sericeum*) grassland, and
- Brigalow—Silver-leaved Ironbark (*Eucalyptus melanophloia*) woodland.

Two major changes have been recorded. Firstly, some of the plant communities have been replaced by adjoining communities. For example the *Dichanthium sericeum* grassland has disappeared and been replaced by *Eremophila deserti* shrublands with emergent Brigalow trees. In the mixed woodland, trees of Silver-leaved Ironbark have been replaced by Brigalow and no regeneration of silver-leaved ironbark has occurred.

The second major change relates to the structural character of the vegetation. The total basal area of canopy trees was similar in the 1960s and 2005 measurements but this was the nett result of a substantial increase up until the early 1990s followed by a marked decline. Density showed a similar pattern though there was a slight decline overall. Since the 1960s a decline in the basal area of Brigalow and eucalypts has been matched by increases in Belah (*Casuarina cristata*) and Narrow-leaved Bottle Trees (*Brachychiton rupestris*). However whilst the density of understorey trees, shrubs and tree regeneration has decreased since the 1960s, the most dramatic decline has been in the density of lianas.

Figure 1. Aerial photograph of Brigalow Research Station, showing reference area at the top. Source: Queensland Department of Environment and Resource Management.

*Figure 2. Interior of Brigalow reference area showing Brigalow–Wilga (*Geijera parviflora*) woodland, part of the Brigalow continuum on clay soils. Photo: Bill McDonald.*

Conclusions

The narrow reference area has resisted invasion from exotic species. Exclusion of fire and domestic stock has been mainly responsible for the maintenance of the integrity of the conserved area. Propagules of aggressive exotic species have penetrated the reference area but never persisted as potential threats. However the conservation of areas of vegetation does not ensure that this protected vegetation will remain stable. Climate change has certainly modified the initial vegetation. Some communities are being lost and changes in dominance are occurring. Because the reference area comprised a series of related communities, ecotones have provided opportunities for ordered change. However, only time will reveal whether the observed changes are part of cyclical events or the result of a long-term climatic change.

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Editor's Note

The future of the reference area has been clouded by the decision of the Queensland Government to sell off Brigalow Research Station, apart from an area of 150 ha adjacent to the eastern end of the reference area, which incorporates the Brigalow catchment study. Given the history and significance of the reference area, it would seem to be a high priority for it to be retained and maintained as a continuing long-term monitoring site that is an integral component of climate change research in the Australian rangelands.

The benefits of restored linear vegetation corridors for biodiversity conservation—a case study

Stuart Johnston[1] and Roger Good[2]

[1]Corporate Environmental Manager, Transgrid.

[2]Research Associate, Australian National Botanic Gardens, Canberra. Email: rgo03227@bigpond.net.au

Linear corridors of native vegetation are significant links between larger remnant areas of native vegetation, in terms of biodiversity conservation and movement of native fauna across the landscape. This is particularly important in regions where extensive decline or clearing of native woodlands for agriculture and other agricultural industries has occurred, e.g. the western slopes of New South Wales (NSW). Unfortunately in many regions the decline or loss of native vegetation linkages has contributed to larger remnant patches of native vegetation being 'islands' in a landscape of cleared agricultural lands. In these regions the restoration and re-establishment of the vegetation linkages can be readily achieved by replanting of trees and shrubs together with the natural regeneration of native species.

In areas of extensive native woodlands and forests, infrastructure and service easements such as powerlines have also resulted in fragmentation of the vegetation and restricted the range and distribution of some native animals that are reliant upon large areas of woodland and forest. The maintenance of powerline easements has generally involved regular slashing and chemical spraying to suppress regrowth of the native vegetation, but over the past decade more ecologically based techniques have been applied to maintenance and restoration work programs.

The TransGrid experience

In 2001 TransGrid—the owner, operator and manager of some 12 500 km of high voltage transmission lines in NSW—undertook maintenance works over some 70 km of transmission lines in Kosciuszko and Namadgi National Parks, resulting in clearing of all native vegetation and a mineral earth swathe through them (Johnston and Good 2004).

Restoration of this bare earth corridor commenced in May 2001, but only after consideration of the ecological challenges to restoration that the cleared powerline easements presented. The restoration program was completed in September 2003. After an extensive area of restoration works was burnt in the January 2003 bushfires, further works were undertaken between April and November of that year.

Restoration objectives

The objectives of the restoration works were not simply to replace the topsoil and to revegetate the denuded areas, but to establish a range of native shrubland and herbaceous species habitats, through the reshaping of easement lands and the replanting of local native shrubs and grasses. This was achieved through the planting of many hundreds of thousands of tubestock of species from the local area (mostly leguminous species of *Acacia*, *Daviesia, Hovea, Oxylobium* and *Pultenaea*) and the sowing of all the easements with native grasses and groundcover plants. A good cover of native grasses was achieved within three years while a mosaic of native shrub patches took several more years, particularly those regenerating shrub areas impacted by the 2003 bushfires.

Acacia rubida *(top) and* Hovea rosmarinifolia *(bottom), two species used in TransGrid restoration plantings. Photos: Murray Fagg.*

Dense shrub plantings

Specific plantings of shrubs in dense clusters were made at and along the 'ecotone' between the open easement vegetation and the forest and woodlands through which the easements pass. This was done in recognition of the plant species composition that occurs in these areas in the natural state, and their significance for many native fauna and avifauna species.

The planting of mainly leguminous shrub species in these clusters was done on the basis of their ease of seed collection and propagation, their growth rates and the range of structural habitats and food range they provide, as well as their ease of maintenance through ecologically based burning, slashing and mulching.

The patches of dense shrub were established to provide habitat for small birds crossing the powerline easements and for birds that would utilise the easements as local or regional flyways. As the easements traverse undulating to steep terrain and occur over a large altitudinal range, the shrubland patches also provide transient refuge and feeding habitat along the easements for birds and several small mammals that occur at or within specific elevation ranges.

Monitoring

Following the completion of the restoration and revegetation program in 2004 a semi-permanent monitoring program was established. This aimed to assess the stability and sustainability of the restoration works, the trends and condition of the planted and natural vegetation regeneration, and the use of the restored native vegetation by birds and animals. The monitoring sites have been maintained to the present time.

As was expected, the open native grassland that was created was attractive to kangaroos, wallabies and wombats, which placed considerable grazing pressure over several years on the rate of regeneration of the planted shrub material. As the shrubs gained height, size and density, the numbers of bird species utilising the grassy shrubland patches increased, from two or three to 31 where the movement of birds both across and along the easements was occurring.

Also of interest is that the number of bird species utilising the easement as a 'flyway' exceeded the number of species recorded in the adjacent and extensive forests and woodlands through which the easements occurred. This may be a result of the ease of observation along the easements, but is probably also a response to the additional habitats provided for many of the smaller bird species, particularly at the edges of the easements.

Discussion

The restoration and revegetation of linear corridors linking larger areas of remnant native vegetation in cleared landscapes is now well recognised and is increasingly being carried out. Less well recognised and implemented is the restoration of linear infrastructure easements that dissect and fragment large areas of natural vegetation, particularly powerline easements where maintenance in the past has been one of vegetation suppression and removal.

The 'maintenance disaster' that occurred in the Snowy and Brindabella mountains in south-east NSW and the Australian Capital Territory in 2001 resulted in a complete review of the TransGrid easement maintenance programs. This lead to an emphasis on ecological understanding and the ecological principles of rehabilitation, revegetation and restoration as the basis for any future powerline maintenance programs. Where this approach has been taken, it has resulted in increased biodiversity on the easements, and contributed to the movement and increased distribution of native plants and animals across the regional landscape.

The monitoring program has identified a continuing increase in fauna and avifauna use of the easements since the restoration works were carried out, to the extent that observed native bird numbers using the easements exceed those recorded for the adjoining forests and woodlands. This increasing use is focussed on the ecotone area and the diverse clusters of shrub patches planted as part of the restoration program.

This new approach to maintenance by TransGrid has also led to the company's support of the 'corridors of green' program on rural lands, such that remnant native vegetation is linked with other remnant vegetation on neighbouring rural properties. It has also focussed much research and field trials of plant species suitable for restoration programs, particularly in sensitive areas such as conservation land and habitat of threatened species and ecological communities.

Conclusion

The restoration of cleared linear corridors that traverse and fragment larger areas of native vegetation (including reserves) can contribute greatly to biodiversity conservation and the movement of native biota. Restoration of a severely damaged or denuded linear corridor, as experienced with the TransGrid powerline easements in Kosciuszko National Park and Namadgi National Park, also provides an opportunity to recreate habitats for specific flora and fauna species that may be under threat or of restricted distribution.

Cleared easements should therefore not be considered as always being detrimental to ecosystem or species decline. Restoration to near-natural corridors can have real benefits to biodiversity conservation, and contribute to individual species survival if the restoration works are planned and implemented using ecological principles and practices.

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Restoring critically endangered grassland on roadsides in the Victorian Volcanic Plain

Frank Carland and Natasha Kennedy

VicRoads Western Region, Wendouree, Vic. Email: frank.carland@roads.vic.gov.au

Roadsides support some of the most important remnants of the Natural Temperate Grassland of the Victorian Volcanic Plain, which is listed as Critically Endangered under the federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Australian Government 2008). This grassland community is highly fragmented in an agricultural landscape and is subject to threatening processes including overgrazing, altered fire regimes, expansion of the area under cultivation, weed invasion, fertiliser application and inappropriate use of herbicides.

The suitability of the Victorian Volcanic Plain for agriculture has been the major contributing factor to the annihilation of most of the grassland community. Agriculture in the region was founded on the grazing industries, principally sheep. Broadacre cropping has expanded considerably in recent years, largely due to a decline in the wool industry and a drier climate.

The need for stock routes in the era prior to modern transport has left as its legacy a network of three chain (60 m) wide road reserves crisscrossing the plain. They combine with other linear reserves to form important refuges and corridors vital for the migration and translocation of grassland species in response to climate change. Many of these former stock routes and associated roadside reserves are now part of the arterial road network managed by VicRoads.

VicRoads

VicRoads is the Victorian State Government agency responsible for the construction, maintenance and safe and efficient function of Victoria's freeways, highways and arterial road network, i.e. M, A, B and C class roads.

In VicRoads' Western Region the Rural City of Ararat is a hotspot for Victorian Volcanic Plain grassland remnants. The roadside reserves of the Western Highway (A8), Glenelg Highway (B160), Ararat-Mortlake Road (C148), Maroona-Glenthompson Road (B180) and Rossbridge-Streatham Road (C182) all support the EPBC-listed grassland community and also individually listed species that comprise or are dependent on the grassland. These include the Endangered Hoary Sunray (*Leucochrysum albicans* var. *tricolor*), Endangered Button Wrinklewort (*Rutidosus leptorrhynchoides*), Vulnerable Clover Glycine (*Glycine latrobeana*), Critically Endangered Golden Sun Moth (*Synemon plana*) and Vulnerable Striped Legless Lizard (*Delma impar*).

As a corporate body, VicRoads is proactive in ensuring that road construction and maintenance works are undertaken in an environmentally sound manner.

The VicRoads Environment Strategy 2005-2015 has identified protecting biodiversity as part of a key strategic direction. This strategy lists 'identifying opportunities for vegetation and habitat enhancement in the context of the broader landscape' as a priority. It is supported by a range of issue-based documents such as Biodiversity Guidelines, Roadside Management Strategy and Roadside Conservation Management Plan Guidelines. VicRoads regions apply the key principles of these documents to management activities. Western Region is no exception and has implemented several grassland restoration projects within the Rural City of Ararat. A grassland restoration project on the Glenelg Highway is discussed below.

Glenelg Highway Grassland Restoration Project

In 2004 VicRoads commissioned a report from the University of Ballarat that detailed the roadside flora and provided management recommendations for the Glenelg Highway road reserve between Wickliffe and Glenthompson in Western Victoria (Leversha and Gowans 2004a, 2004b). The revegetation of areas where tree plantations had been removed and the use of local provenance seed or cuttings for revegetation were included in a long list of recommendations.

Meanwhile, during 2004-07 the Grassy Groundcover Restoration Project headed by University of Melbourne Research Fellow Dr Paul Gibson-Roy made significant advances in the establishment of native grasslands by direct seeding.

In 2007 VicRoads chose to restore the sites of two former tree plantations, located in high quality grassland approximately 5 km west of Wickliffe. At one site there was prolific regeneration of the introduced Golden Wreath Wattle (*Acacia saligna*). There was also some regeneration of *Dianella* spp., *Eutaxia* spp. and other natives that were salvaged for later replanting. A vegetation quality assessment recorded a habitat score[1] of 0.37 for this site. The other site supported little regeneration apart from some grasses and recorded a habitat score of 0.23.

[1] Score used in the Habitat Hectare system in Victoria. A pristine grassland would have a theoretical score of 1.00; the lower the score, the more degraded the remnant.

Figure 1. Scalping grassland restoration site, May 2009. Photo: Frank Carland.

These sites, approximately 0.3 ha in total, were scalped in May 2009 in preparation for sowing (Figure 1). The overburden was utilised in the rehabilitation of a former quarry nearby. The earthmoving contractors, aware of a Hoary Sunray population just centimetres from the works area, were meticulous and no damage occurred to the adjoining grassland.

Sowing occurred in September 2009 using a purpose-built seeder. All seed used was either locally collected or harvested from an irrigated seed production area consisting of parent plants propagated from locally collected seed. (The use of irrigated seed production areas is an ethical method of producing seed in sufficient quantities to revegetate reasonably large areas; the regular turnover of parent plants also ensures genetic diversity is maintained). Immediately following the seeding operation salvaged and retired parent plants from the scalped area were replanted.

The results of the Restoration Project have so far exceeded expectations (Figure 2). Several thousand Hoary Sunray and Button Wrinklewort plants have germinated and established. Other threatened or iconic species such as Clover Glycine, Yam Daisy (*Microseris lanceolata*) and Featherheads (*Ptilotus macrocephalus*) have germinated in good numbers while the establishment of common native grass and daisy species is extensive.

Figure 2. Germination of grassland species seven weeks post-sowing. Photo: Natasha Kennedy.

The sites are expected to be fully established around the end of 2011, by which time they should have achieved a habitat score of 0.75-0.85 to match their environment. The two former tree plantations that were once a visual blight and a physical threat to the grassland will then be regularly burned along with the adjoining Glenelg Highway road reserve to form part of a strategic firebreak.

Future management

Once active site restoration is complete, the sites will be managed to achieve the following goals:

- as strategic firebreaks, in consultation with Country Fire Authority, Wickliffe Fire Brigade, community members and Ararat Rural City Council;
- as potential sites for offsetting native vegetation loss under the guidance of Victoria's Native Vegetation Management Framework (The State of Victoria 2002); and
- for the intrinsic value of the grassland community and the individual flora and fauna species that comprise or are dependent upon it.

Further degraded areas requiring significant intervention may also be identified for rehabilitation and restoration.

Acknowledgements

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Tasmania's temperate grassland linear remnants and the Tunbridge long paddock

Louise Gilfedder

Department of Primary Industries, Parks, Water & Environment, Hobart. Email: Louise.Gilfedder@dpipwe.tas.gov.au

Tasmania's Midlands: fragmented native vegetation in an agricultural landscape

Tasmania is renowned for its world class reserve system protecting 44.4% of the terrestrial landmass. However, there is a bias towards alpine and rainforest areas and there are significant plant conservation issues in our lowland agricultural regions where land settlement occurred early in the history of the State and land clearance extensive. Linear reserves such as transport corridors are an important complement to conservation efforts in our farmlands, but maintaining the values on these reserves has proven difficult.

Tasmania has nine bioregions; they are an important basis for conservation planning. Reservation analyses at the bioregional level indicate the National Reserve System target of at least 10% of each bioregion protected in the reserve network is achieved in all but one bioregion—the Tasmanian Northern Midlands. The latter has been identified as one of 15 biodiversity hotspots in Australia, with nationally important natural values. Many species are endemic to the area and are found nowhere else. Over 500 ha of native vegetation in this region is in linear remnants, and over 3000 ha is in small remnants less than 5 ha in size (Department of Primary Industries, Parks, Water & Environment (DPIPWE) unpublished data).

The region has significant biodiversity values, with threatened native vegetation communities and threatened species and their habitats (Gilfedder *et al.* 2003). The valleys and hills were once home to extensive native grasslands and woodlands, sadly now severely depleted and fragmented. The once widespread Lowland Temperate Grasslands have recently been listed under national legislation as Critically Endangered (www.environment.gov.au/epbc/publications/pubs/lowland-native-grasslands-of-tasmania.pdf)

Tunbridge Tiers Road long paddock: an example of linear remnant management

The Tunbridge Tiers Road extends from the lowland temperate grasslands and woodlands of Tunbridge at 200 m altitude to subalpine grasslands and woodlands at 960 m altitude on the eastern Central Plateau. It is a 'long paddock', a remnant of a past grazing tradition where sheep were moved up to highland pastures over the summer period. It was identified in the mid 1980s as an important refuge for threatened lowland grassland plant species.

In 2002 the Midlands Bushweb project provided financial assistance for the erection of interpretive information on the importance of the long paddock to threatened grassland conservation. Bushweb was a community-based incentives program funded through the Australian Government's Natural Heritage Trust. Today few Midlands graziers retain these summer pastures and if they do they tend to transport their stock by truck. The long paddock is rarely used and there have been ecological consequences—but more of that later.

Tunbridge Tiers Road has unusually wide road verges for Tasmania—wide enough to allow passage for a big mob of sheep several times a year. The mechanical disturbance and browsing provided the right conditions for a range of disturbance-dependent grassland plant species to flourish.

Grasslands Candles (*Stackhousia subterranea*) is a Tasmanian grassland endemic herb, and the Tunbridge long paddock has been identified as habitat for an important population of the species. Its deep cream or yellowish flowers have a distinctive strong daphne-like perfume, probably to attract nocturnal pollinators such as moths.

In 1985 the Grassland Cupflower (*Colobanthus curtisiae*) was discovered at a cemetery in Campbell Town in the heart of the Midlands. Speedy taxonomic work ascertained that this was a new endemic species for Tasmania, and Herbarium staff were despatched to collect more material from the type locality. Alas, the Tidy Towns syndrome had struck and in the intervening period a cemetery clean-up had rendered the type population locally extinct. A second population was discovered on the Tunbridge Tiers roadside, but roadside scraping to widen the road as part of the nation's Bicentennial works program almost removed this population. Luckily it has now been recorded from other Midlands grassland sites and its situation (extinction list) is less precarious.

The Tunbridge Tiers Road also played an important role in the rediscovery of a tiny Tasmanian endemic sedge species. Hidden Bog-sedge (*Schoenus absconditus*) was first collected in the Midlands in the 1880s by an early Tasmanian botanical collector Miss Emma Oakden. No further records were known and it was considered possibly extinct until 1992 when thousands of individuals of this cryptic species were identified on the Tunbridge Tiers Road. Further searches revealed that where there was suitable grassland habitat Hidden Bog-sedge tended to be present, just poorly collected.

Long-term monitoring plots were established for a number of the grassland species in 1992–93. They were re-measured a decade later by the Threatened Species Unit. The results were alarming! In the absence of continued use by sheep the roadsides had converted to dense swards of thick rank grasses. Gone were the short grassy herbfields rich in wildflowers. Dense patches of grassland candles had disappeared, and large mats of cupflowers had died of old age but there had been few replacements—too much competition from the grasses. Further, weeds had become more prolific, including mats of gorse that previously had been kept in check by sheep grazing of tender young new growth.

This monitoring has provided a very clear example of the role sheep grazing can play in maintaining disturbance regimes to retain threatened species habitat and lowland grassland condition. Discussions are currently underway with the roadside manager (Northern Midlands Council) to implement ecological burning regimes.

Systems and tools to improve conservation management

The Department of Infrastructure, Energy and Resources is the management authority for important linear remnants in Tasmania. They have implemented a management system that includes the development of management plans and maintenance schedules for key roadsides along the Midlands Highway, with maps that detail locations of rare, vulnerable and endangered plants and their required management. The production of an attractive roadside management manual for the Northern Midlands Council roadside managers has helped workers to identify important roadside remnants (via maps) and key natural values (through clear images and descriptive information). Despite these systems and tools, all is not rosy: many populations of threatened and important roadside vegetation remnants and faunal habitat have been lost since the system was developed. Linear remnants are important for conservation but provide serious management challenges!

Linear remnants provide important landscape connectivity in a changing climate

The Tunbridge Tier roadside and many other linear remnants will increasingly be recognised for their role in providing landscape-level connectivity along environmental and altitudinal gradients that are an important component of climate change adaptation planning, particularly in fragmented landscapes. These corridors may provide for movement of plant and animal species to less hostile environments as climate conditions change. Yet another reason to look after linear remnants!

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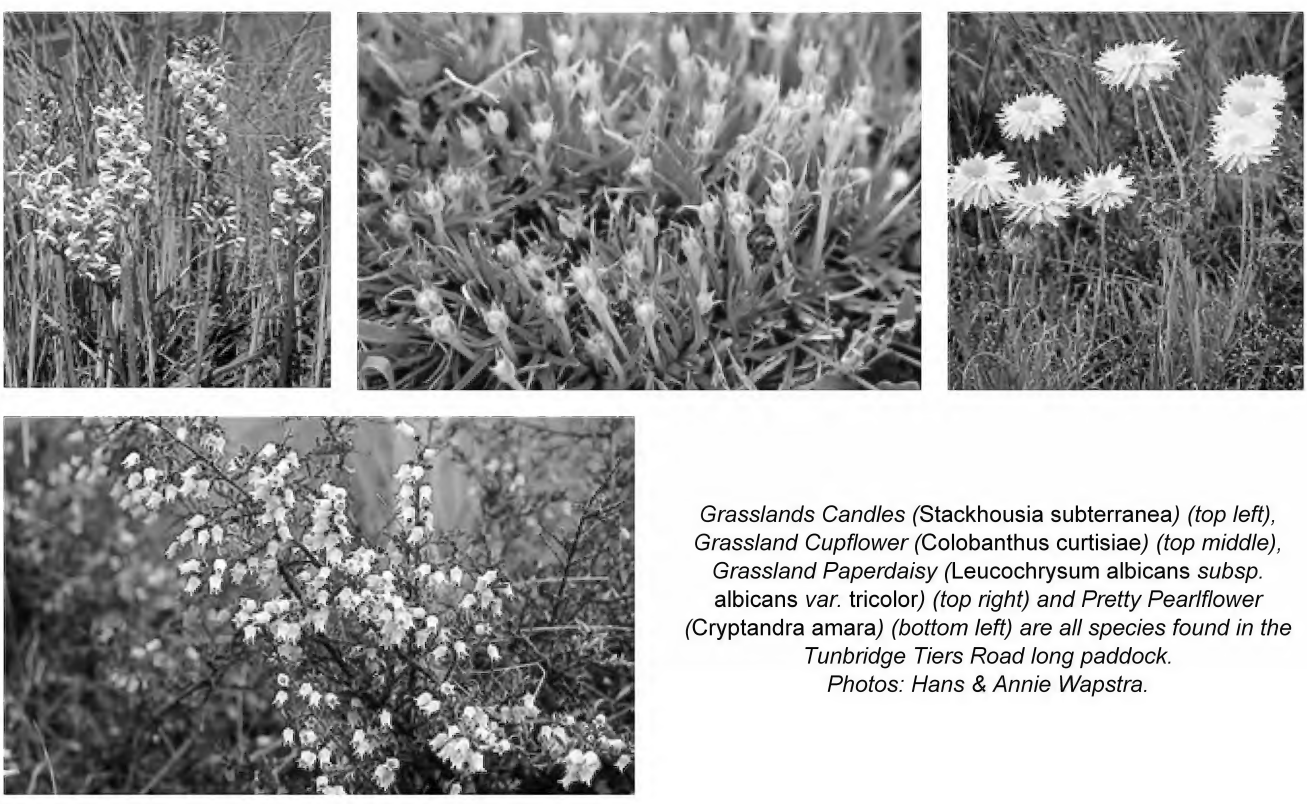

*Grasslands Candles (*Stackhousia subterranea*) (top left), Grassland Cupflower (*Colobanthus curtisiae*) (top middle), Grassland Paperdaisy (*Leucochrysum albicans *subsp.* albicans *var.* tricolor*) (top right) and Pretty Pearlflower (*Cryptandra amara*) (bottom left) are all species found in the Tunbridge Tiers Road long paddock.*
Photos: Hans & Annie Wapstra.

Threatened flora and Western Australia's roadside remnants

Caron Macneall

Roadside Conservation Committee, Kensington, WA. Email: caron.macneall@dec.wa.gov.au

Introduction

Roads, and therefore road reserves, were originally created for the use of horse and cart. These same road reserves must now safely accommodate large numbers of high-speed cars, large heavy haulage trucks and wide loads. Unfortunately, the ever-widening road width required to accommodate modern-day vehicles is slowly reducing the width of road reserves containing remnant native vegetation.

Roadside vegetation plays a vital role in the conservation of Western Australia's unique flora and fauna. It provides essential habitat for rare and threatened species, forms corridors that facilitate species movement and, in many areas, comprises a significant part of the remaining native vegetation. However, roadside vegetation has inherent problems for conservation including edge effects, such as fertiliser and herbicide drift, wind exposure and weed invasion, which have a significant impact on the long-term viability of roadside vegetation populations. These are often exacerbated by the simple act of road maintenance and the drastic impacts of road construction and maintenance.

Yellow 'Hockey Stick' (right hand corner of photo) marking a population of rare flora, Warrachuppin Road, Shire of Westonia. Photo: D. Mickle.

Threatened species along roadsides

Approximately 8000 species of native flora are thought to occur within the south-west of Western Australia, of which approximately 70% are endemic to the region. At last count the Department of Environment and Conservation (DEC) had declared 391 flora species as 'Rare' (see <http://florabase.dec.wa.gov.au/conservationtaxa> for definition). It is estimated that of the total number of significant flora species (including threatened and priority flora), 30% have populations in roadside vegetation, with three rare flora known only from roadside vegetation populations.

Marking for protection

Conservation of these populations of threatened flora, which already occur in high risk sites is not an insurmountable task. Local governments, along with Main Roads WA, DEC and the Roadside Conservation Committee undertake marking programs to physically demark populations of primarily Declared Rare flora *in situ*. In some cases Priority 1 and Priority 2 flora are also marked. Marking is done through the use of a yellow 'hockey stick' or stake with a plate welded to the top (see illustration). These not only serve to clearly define the boundary and buffer of a population but also prompt the attention of any works crew undertaking any ground disturbance activities in close proximity to the flora population.

Education is important

While some local governments remain focused on the traditional 'roads, rates and rubbish', there has been a shift in attitudes both within the local communities and in local government staff. More and more local government engineers recognise the values of roadside vegetation and are therefore interested in conserving what remains. Local governments are, however, constrained by ability, knowledge and resources, which makes the Roadside Conservation Committee's role in education and liaison essential.

New workshops for managing native vegetation in travelling stock reserves

Sue Mathams

Australian Network for Plant Conservation Inc., Canberra. Email: sue.mathams@environment.gov.au

The Australian Network for Plant Conservation (ANPC) has received a project grant from the NSW Environmental Trust to develop and facilitate workshops on managing native vegetation in travelling stock reserves (TSRs) for TSR managers.

The project, *Managing Native Vegetation in Travelling Stock Reserves* will involve:

1. conducting six, two-day workshops (over three years) in regional NSW to engage on-ground managers of TSRs to increase ecological knowledge and plant conservation skills, and
2. developing course materials that will be a resource for further workshops and other training opportunities outside the project funding and which could also be applied to other linear reserve management.

The Travelling Stock Reserve network includes many sites important for conservation of native species and ecological communities, particularly in the wheat-sheep belt where remnant native vegetation may comprise less than five per cent of the landscape. This project focuses on conservation of TSRs in Box-Gum Grassy Woodland and Natural Temperate Grasslands, including threatened ecological communities listed under state and commonwealth legislation.

The aim of the project is to improve biodiversity conservation on TSRs. The workshops will provide on-ground managers with enhanced knowledge and skills to identify and manage native plant species and communities in their TSRs and threats to them. The workshops will also help develop the capacity of managers to access relevant advice and ecological knowledge, and to familiarise them with multiple use management options consistent with conservation goals.

Development and delivery of these workshops involves collaboration with the project partners: Murrumbidgee, Central West and Border Rivers-Gwydir catchment management authorities (CMAs), the Livestock Health and Pest Authority State Council, TSR Rangers, the Grassy Box Woodlands Conservation Management Network and Friends of Grasslands. The ANPC would also like to thank the NSW Roadside Environment Committee for its support for this project.

Workshop content and delivery is currently being developed. As part of this process, ANPC has conducted discussion groups and email surveys with TSR Rangers. It has also held a major focus group for the proposed workshops, to identify their major issues in relation to TSR conservation management and their requirements for training. The following topics were identified: Plant Identification and ecological communities; Grazing management; Conservation values; Background history; Threats; Conservation agreements, partnerships and incentives (e.g. payments from CMAs to manage TSRs for their conservation values).

We plan to run the first workshops in the Wagga region. For more information on the project, or to contribute your energy or expertise please contact Sue Mathams on phone 02 6250 9523 or sue.mathams@environment.gov.au.

Grassy Box Woodlands field day at the Coolamon Road TSR, August 2010 – An event organised by Communities in Landscapes. Photo: Sue Mathams.

Geographical Information System-based habitat modelling and conservation assessment of threatened plants on Cape York Peninsula

Bruce Wannan

Department of Environment and Resource Management, Atherton, Qld. Email: bruce.wannan@epa.qld.gov.au

Introduction

There are 219 plants listed as threatened on Cape York Peninsula, an area of 12.7 million hectares. Many are known from less than five locations, due to the difficulty of sampling in this remote and often inaccessible region. Consequently, modelling has been used to predict the habitat of a number of threatened plants on the Peninsula.

Poon and Margules (2004) used modelling to predict additional habitat for two threatened species that are endemic to the Peninsula: the grass *Coix gasteeni* and shrub *Jedda multicaulis*. Subsequent fieldwork discovered new populations of both plants.

I also used modelling to predict the habitat of the restricted endemic shrub *Teucrium ajugaceum* (Figure 1). Until 2004 this plant was listed as extinct under the Queensland *Nature Conservation Act 1992* as it had not been seen for over 100 years. Following its rediscovery near Musgrave, I successfully used Geographic Information System- (GIS-) based habitat modelling to predict further populations across the southern part of the Peninsula. The model used information collected from 101 field sites and existing mapping (geology, regolith, vegetation, soils) to accurately predict that its key habitat area was sandy rises dominated by Stringybark (*Eucalyptus tetrodonta*) and Clarkson's Bloodwood (*Corymbia clarksoniana*).

Figure 1. Teucrium ajugaceum *rediscovered in 2004. Photo: Bruce Wannan.*

In 2008, two restricted endemic species of *Indigofera* (Fabaceae) were described from the Peninsula (Wilson and Rowe 2008). *Indigofera polyclada* was described from two localities near Weipa and *I. wannanii* from a single locality near Musgrave. Both species were described as Endangered due to their small population sizes and threats from either bauxite mining (*I. polyclada*) or gravel extraction (*I. wannanii*). Due to the lack of information on the populations of these species, a study to assess their conservation status was initiated in 2008-9 with support from the Cape York Peninsula Natural Resource Management Group under its Gap-Filling Program.

Methods and outcomes

The project involved field surveys and development of a GIS-based model to establish the distribution and conservation status of each species. Initial habitat preferences were determined using specimen notes, as well as geology, soils, regolith and vegetation mapping.

Indigofera polyclada

Specimen notes and mapping suggested a broad range of biophysical attributes at the two localities of *I. polyclada*. Consequently, it was decided to search areas adjacent to the existing records to extend the local distributions and more accurately assess biophysical attributes. The two previously known populations were relocated in June 2008 and found to occupy an area of approximately 5 ha overall. Despite extensive searches in the vicinity of each location, no further populations were found.

Close inspection of the two sites suggested that its habitat may be described by:

- soils: skeletal and most similar to those described as Scorpion;
- vegetation: regional ecosystems 3.7.3, 3.7.4 and 3.7.5 (see Sattler and Williams 1999); and
- geology: stony rises/slopes on exposed or shallowly covered duricrusts generally correlated with the Bulimba Formation (KTi) or more weathered elements of the Rolling Downs Formation (Klr).

A habitat model was developed based on an intersection of soil, vegetation and geology which predicted a core habitat on the highly weathered soils between Cullen Point and Aurukun (Figure 2). The pattern of modelled habitat appears generally fragmented and in many areas quite localised. Additionally, the modelled habitat is distant from most access roads which may also explain the absence of collections.

Figure 2. Core habitats and type localities of Indigofera polyclada *and* I. wannanii.

Indigofera wannanii

Analysis of habitat for *I. wannanii* at the type locality suggested a narrow range of biophysical attributes based on:

- geology: Kitja Gneiss;
- regolith: highly weathered saprolite on low hills; and
- vegetation: Regional Ecosystem 3.11.11.

Searches in May–June 2008 in appropriate localities were unsuccessful. However, during unrelated fieldwork in August 2008 two new records were collected 60 km south-west of the type locality. Following analysis of data from these records, a new habitat model was developed which identified a core habitat based on Regional Ecosystem 3.11.11 but on a slightly different geology. The core areas (Figure 2) were predicted to occur on the metamorphosed sediments in the headwaters between the Edward and Coleman Rivers west of Musgrave.

The accuracy of this model was confirmed during field work in April 2009. The predicted area appears to be the key habitat for the species but there had been no collections due to the difficulty of access during the wet season. Interestingly, the species' type locality is at the eastern periphery of its modelled habitat.

Dicussion

The initial development of habitat modelling for *I. polyclada* and *I. wannanii* proved difficult due to their low number of known locations. Searches near these localities and in the initial modelled habitat were unsuccessful for both taxa.

The results for *I. wannanii* were improved by the subsequent fortuitous discovery of two additional populations which enabled a more effective model to be developed. Following successful ground truthing of the predicted populations, its status was changed from Endangered to Near Threatened. The large habitat area is offset by the substantial impacts of gravel pits there.

The development of a habitat model for *I. polyclada* continues to be hampered by the absence of specimens and its apparently localised habitat. A tentative model has been developed based on soil, vegetation and geology which identifies areas of weathered tertiary surfaces (duricrust) on the central Peninsula. The effectiveness of this model remains to be tested, and the species' conservation status is still uncertain.

The difficulty of locating both species during field work has made the project more challenging. At least part of the difficulty is that both species flower and fruit in the wet season (January–March) when access to all parts of the Peninsula is very difficult. Field surveys after these times may produce equivocal data as both species die back to underground rootstocks.

Conclusion

The development of habitat models based on GIS has been proven to be a successful and reliable tool for locating further populations of at least four species of threatened endemic plants on Cape York Peninsula. This is, at least in part, due to the provision of accurate mapping developed from the Cape York Peninsula Land Use Strategy in the 1990s for vegetation, soils, regolith and geology. Experience from the current work suggests that model reliability greatly improves with the addition of field information from more populations.

There is a strong potential for this approach to be used successfully to identify additional habitat for other poorly known species from the Peninsula such as *Stemona angusta* (listed as Vulnerable) and the unlisted *Teucrium* sp. (Birthday Mountain DGF 3516+).

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Building our knowledge of the inter-relationships between plants and insects: some books that assist

Maria Matthes

Ecological Sustainability Consultant, Bagotville NSW. Email: maria@healinghistory.com.au

In the last issue of *Australasian Plant Conservation* (page 33) I reviewed the wonderful CSIRO book *The flowering of Australia's rainforests: a plant and pollination miscellany,* by Geoff Williams and Paul Adam. I suggested that for plant ecologists and conservationists alike the information is there for us to extract and put into a format that will be useful for our work or interest. I also noted that in understanding local pollinator populations, one can start the process of considering the likelihood of pollination success or failure, and appropriate planting arrangements. While detailed accounts and lists of pollinators are provided in the book, we need to be able to find, identify, and understand the species that interact with our local plants.

As much as I love all aspects of plant ecology and evolution, I am equally fascinated by the co-evolution of insects and plants over many millions of years. While invertebrates make up 99% of the world's species diversity, most of which are insects, there are many gaps in our knowledge of the life cycle requirements of most insect species and of their distribution, particularly at local and regional scales. There is a plethora of examples of plant-insect relationships, including those species-specific relationships that have co-evolved. It is these relationships that need to be maintained in conservation land management planning and projects.

The CSIRO has produced a number of guides to assist in the identification of different insect groups, including beetles, katydids, stick and leaf insects, butterflies, moths and dragonflies. I have prepared short reviews of most of these guides to encourage the many people working in plant conservation to look beyond the plants and to begin recording, photographing and documenting insect species, their life cycles and behaviours, the plants they pollinate, their relationship with other insects, and their larval food plants. My experience is that these books will make it easier for plant conservationists to become amateur or professional experts in recording and studying insects.

My reviews of some of these publications are in the Book Reviews section of this issue of *Australasian Plant Conservation*, and on the ANPC website at <http://www.anpc.asn.au/resources/plant_insect_interactions.html>. The reviews are of: *A Guide to the Beetles of Australia* (2010); *A guide to the Katydids of Australia* (2010); *The Complete Field Guide to Butterflies of Australia* (2004); *A Guide to Australian Moths* (2007); and *The Complete Field Guide to Stick and Leaf Insects of Australia* (2009). The CSIRO has also published *The Complete Field Guide to Dragonflies of Australia*, which I have not reviewed.

We are facing a global pollinator and ecosystem crisis, affecting both agricultural and ecological productivity, which requires a greater understanding of the life histories of our insect biodiversity and the role insects play in maintaining the balance. I hope that a few people involved in plant conservation are inspired to take this challenge seriously!

*Botany Bay Diamond Weevil (*Chrysolopus spectabilis*) on a Lomandra leaf (left) and a Fiddler Beetle, also known as the Horseshoe Beetle (*Eupoecila australasiae*) on* Melaleuca decora *flowers (right). Photos: Murray Fagg.*

What family does this plant belong to now?

Rosemary Purdie

c/- Centre for Plant Biodiversity Research, Canberra. Email: Rosemary.Purdie@environment.gov.au

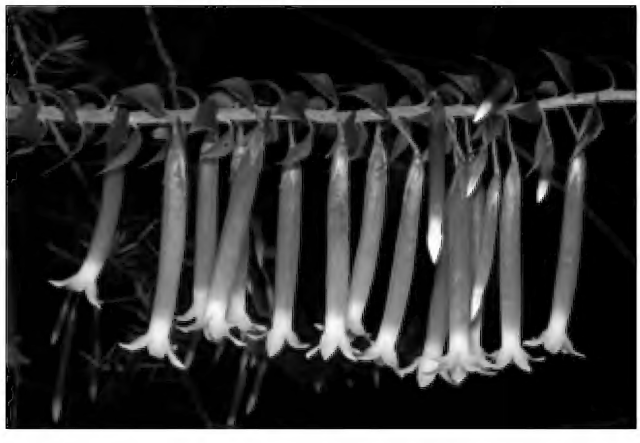
The increasing amount of molecular data relating to the genetic makeup of plant species has resulted in plant scientists reviewing the relationships between plant genera, the concepts of plant families, and assigning genera to the most appropriate family based on this new understanding. The work is a global collaborative effort and is resulting in a new systematic sequence for angiosperms. The currently accepted sequence is sometimes referred to as APGIII, based on the work of Angiosperm Phylogeny Group III. As more data is obtained, it is probable that further changes may occur. Further information can be found on the Angiosperm Phylogeny website (www.mobot.org/MOBOT/research/APweb/), and an overview and history of the work at http://en.wikipedia.org/wiki/Angiosperm_Phylogeny_Group.

The new phylogenetic relationships and resulting family classification from APGIII have resulted in considerable change for some plants, and can easily lead to confusion among those not involved in the research (including many community members doing on-ground conservation work). For example, the 'heath' family, Epacridaceae, is no longer recognised as a separate family and all the genera previously assigned to it are now included within the family Ericaceae. Some genera formerly in the family Euphorbiaceae are now in the family Phyllanthaceae (e.g. the genus *Phyllanthus*) or the family Picrodendraceae (e.g. the genus *Petalostigma*) but other genera (e.g. *Bertya*, *Chamaesyce*, *Ricinus*) remain in the family Euphorbiaceae.

Other major changes in APGIII include:

- all the genera formerly in the families Mimosaceae (e.g. *Acacia*) and Caesalpiniaceae (e.g. *Senna*) are now placed in the family Fabaceae along with the typical 'pea-flowers',
- all the genera formerly in the families Bombacaceae (e.g. *Adansonia*), Sterculiaceae (e.g. *Brachychiton*) and Tiliaceae (e.g. *Corchorus*) are now placed in the family Malvaceae, and
- many genera formerly in the family Scrophulariaceae are now placed in other families, including Plantaginaceae and Orobanchaceae.

The APGIII system has been adopted for the Australian Plant Census, i.e. the names accepted by the heads of the Australian herbaria for the nation's vascular flora, for national purposes (e.g. listing plants under the *Environment Protection and Biodiversity Conservation Act 1999*). The Australian Plant Census website provides two very useful 'translation tables' to help navigate the changes.



Epacris longiflora, *along with all other species of* Epacris, *is now placed in the family Ericaceae; the family Epacridaceae is no longer recognised. Photo: Murray Fagg.*

The first translation table (http://www.cpbr.gov.au/chah/apc/family-translation/brummitt-APC-gen.html) provides:

- an alphabetical list of vascular plant genera (first column),
- the 'old' family name (second column headed 'Family according to Brummitt'), and
- the new family name (third column headed 'APC family Mabberley 2008').

The second translation table (http://www.cpbr.gov.au/chah/apc/family-translation/brummitt-APC-fam.html) provides:

- an alphabetical list of 'old' family names (first column headed 'Family according to Brummitt'),
- a list of genera, ordered alphabetically within each old family (second column), and
- the new family name (third column).

In both tables, yellow highlighted rows clearly show those genera that have 'shifted family' because of the work of Angiosperm Phylogeny Group III.

It is important to note that not all the changes in APGIII (and shown in the translation tables referred to above) are accepted by all Australian herbaria. For example, the Australian National Herbarium in Canberra will continue to recognise the families Mimosaceae, Caesalpiniaceae and Fabaceae (rather than assigning all the genera in the three families to the Fabaceae). Its physical plant collections (and those of most other Australian herbaria) will remain in the 'old' family order at least in the medium-term, because of the sheer logistical problems and resources required

to re-organise them. The Western Australian Herbarium in Perth however, which is currently relocating to a new building, is using this opportunity to store its collections in the new order. Lists of the 'old' and 'new' families to be used by the Western Australian Herbarium, and genera they will allocate to new families, can be found at <http://florabase.dec.wa.gov.au/articles/sequence/>.

While these changes can be unsettling, especially knowing they are likely to continue as further data become available, do not despair: only about 12.5% of all vascular plant genera in Australia are in a new family under APGIII, which means that 87.5% of genera (and your knowledge) remain intact!

Acknowledgements

Thanks to Brendan Lepschi, Centre for Plant Biodiversity Research, Canberra for helpful discussions about APGIII and its implications.

Petalostigma triloculare, *a species in one of nine genera formerly in the family Euphorbiaceae that are now placed in the family Picrodendraceae. The family Euphorbiaceae is still recognised, and retains 49 genera. Of the other genera no longer in the Euphorbiaceae, 14 have been placed in the family Phyllanthaceae, and one genus in the family Putranjivaceae. Photo: Murray Fagg.*

ANPC in the USA: directions in science and conservation at the Smithsonian Institution

Zoë Smith

Smithsonian Environmental Research Center, Maryland, USA. Email: smithz@si.edu

I am currently a postdoctoral fellow at the Smithsonian Environmental Research Center (the Center), Edgewater, Maryland, USA. This regular report covers some of my experiences in environmental research in the United States and provides recent highlights in science and conservation there. An introduction to this regular report and background on the Center can be found in the 2009 September—November issue of *Australasian Plant Conservation*.

Summer humidity—and drought?

As a weathered Aussie, I scoffed at the mention of summer heat waves; however, the humidity in the Washington DC area makes for a personal sauna if you're out in the field wearing long sleeves (which are essential for keeping out poison ivy). Thankfully sporadic heavy thunderstorms provide occasional relief, even if they are predictably associated with power blackouts and microcosms of mildew forming in shoe closets. Still, being Australian means cherishing rain in any form and my colleagues think I'm a little strange for gushing about the wonderful rainy weather we're having. However, while normally the wettest months of the year, July and August 2010 have seen warmer and drier conditions than usual, with temperatures and low rainfall setting records in many states. Unfortunately this has reduced the vegetable garden output, the corn is stunted, and many of my study orchid populations were noticeably smaller than last year. Zhao and Running (2010) have shown that droughts across the world may have caused reduced plant uptake of atmospheric CO_2.

Science highlights

Advances in fungal biodiversity research

I was recently fortunate to attend a bioinformatics workshop for metagenomic data analysis and the 9th International Mycological Congress in Edinburgh, Scotland. The development of high-throughput DNA sequencing techniques has vastly increased the output of fungal DNA sequence data and better resources are required to process and analyse resulting datasets. Several new pipelines and software are now available for analysing large sequence datasets, improving efficiency and error reduction and the application of metagenomics to better understanding fungal community ecology. The Congress further highlighted the rapid advances in understanding fungal biodiversity and evolution as well as community interactions, disease control, biochemistry and even protecting valuable artwork.

While our knowledge is advancing substantially, what we still know about fungi is that we don't know a lot!

For more information:

- Fungal Environmental Sampling and Informatics Network and NORDFORSK Research Network Workshop: http://www.bio.utk.edu/fesin/FESIN2010/program.htm
- 9th International Mycological Congress: http://www.imc9.info/

The trouble with bees

The Center has recently acquired some new residents—bees. In collaboration with the National Museum of Natural History, three beehives were installed both to help reduce the species' recent decline due to Colony Collapse Disorder and to educate the public about the importance of bees for pollination of food crops. Colony Collapse Disorder describes the recent dramatic decline in honey bee health and survival. Underlying causes are currently unknown but suspected to include increased pesticide use, new or increased populations of parasites and pathogens, and disruption of social systems via immune system stress resulting from declining environmental quality (such as water contamination, and pollen and nectar scarcity). For fellow honey-lovers: it takes 88 500 km of bee travel, two million flowers and up to 4 kg of nectar to make 500 g of honey, so we need to keep those bees flying (in managed populations in Australia, where they are an introduced species).

Declining mangroves

Scientists from the US Geological Survey and NASA have used new fine-scale satellite technology (30 metre spatial resolution) to show that less than half the world's original mangrove forests remain, 75% of which is located in only 15 countries (Giri *et al.*, 2010).

Advancing science education

Science in society

There is an increasing need for improved understanding in society of the importance of conservation science. An effective way for science to reach the community is to bring science to people's doorsteps. To this end, Dr Dennis Whigham (Senior Scientist at the Smithsonian Environmental Research Center) recently engaged a team of local residents to prevent stream erosion by reducing storm water runoff. Many urban estates were built prior to considerations of storm water runoff on local watershed health, which can be negatively impacted by leaching of nutrients and chemicals from lawns. In properties where storm water was most likely to enter street drains, homeowners have installed rain barrels and rain gardens with asphalt diverters to catch water coming off the driveway. While door-knocking can elicit some resistance, the project has demonstrated how one community not only improved river health but also increased community spirit. The next step is to involve the county in diverting storm water from streets; this will require additional resources and funding.

Life after a PhD

Following discussion among postdocs here at the Center, a colleague and I decided to share some of our experiences and information we've gathered that might be useful to other current or prospective postdocs. The material can be found at <http://chronicle.com/article/Making-the-Most-of-Your-Pos/66265/>.

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*Some local wildlife: a bumblebee (top) at the Smithsonian Environmental Research Center, and a butterfly that landed on a fringed orchid (*Platanthera *x.* bicolor*).*
Photos: Zoë Smith.

Research Roundup

Compiled by Kirsten Cowley, Centre for Plant Biodiversity Research, Canberra. Email: Kirsten.Cowley@csiro.au

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Price, J.N., Wong, N.K. and Morgan, J.W. (2010). **Recovery of understorey vegetation after release from a long history of sheep grazing in a herb-rich woodland.** *Austral Ecology* 35(5): 505–14.

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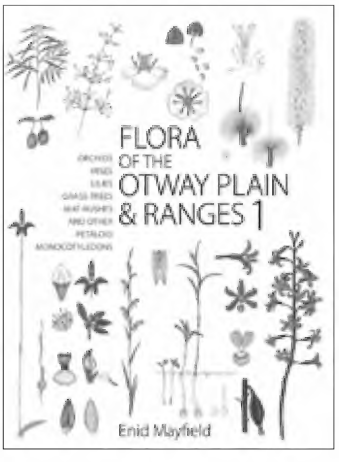
Contributions to Research Roundup are welcome, and should be sent to Kirsten Cowley at the above email address using an email subject heading "APC Research Roundup" or similar. Their inclusion will be subject to available space.

Book Reviews

Flora of the Otway Plain and Ranges 1. Orchids, irises, lilies, grass-trees, mat-rushes and other petaloid monocotyledons

by Enid Mayfield
Publisher: CSIRO Publishing, Collingwood, Vic., June 2010
232 pages with colour illustrations
Paperback, ISBN: 9780643098046, AU$49.95
Available from: www.publish.csiro.au



This book is primarily a field guide and detailed reference for many of the showy understorey flora species in the Otway Plain and Ranges, stretching along the coast and mountains from Portland and Warrnambool to the Geelong and Bellarine Peninsula. It is a comprehensive guide to the petaloid monocots that occur in this ecologically diverse and beautiful region of Victoria. Enid has taken on a formidable group of plants that includes the orchids, irises and those endemic Australian genera that are lily-like, many of which were considered to be part of Liliaceae in the past. The book is dominated by descriptions of orchids with at least 129 species covered or around a third of the species in Victorian, an indication of the richness of the flora in the Otway region.

The book is a great combination of artistic endeavour and scientific illustration, a true and accurate expression of the beauty of nature. Each species has been drawn and painted in colour with great detail and accuracy, and no doubt much study and effort over many years. It also appears to be as up-to-date as possible in regards to taxonomy and nomenclature, no doubt a difficult task in itself considering the flora species covered. The book goes so much further than many field guides that may have selective coverage of species, and should be recognised as part of a detailed flora for the Otway region.

The dominant feature of any flora is the individual taxa descriptions and those in the book are very well done. Each family has its own section and each genus is introduced with a succinct and informative box at the top of the page. Each description includes a detailed drawing of the leaves and overall habit of the plant and close-up drawings of useful features such as flowers, labellums (in the case of orchids) and the tips of leaves (in the case of *Lomandra*). The paintings are very useful in that distinctive features of the plants are considered by the author and depicted clearly. The descriptions include all the typical physical characteristics and notes on habitat, conservation status and flowering times.

This book would be a great resource for budding or entrenched orchid enthusiasts. A whole page of detailed drawings and text introduces the family. Several genera have special introductory sections to help clarify the species, e.g. *Caladenia*, *Pterostylis* and *Thelymitra*. Informative notes on orchid ecology are also included.

The other feature to consider in a flora is the tools included to determine species (without the need to compare a specimen to each individual description). This book doesn't have a dichotomous key but does have various tools to help the user narrow the species. It begins with a 'quick plant finder' where if any of the common name, scientific name or family is known for a specimen, they can be used to determine other names or family. The second and very useful identification feature is 'what flower is this?', where the user can select flower colour, number of petals or flower type to get to the genus. The third identification tool is an overview of the 'characteristics of families', i.e. a concise description of the different families included. The fantastically detailed 'illustrated glossary' also aids the user's botanical study. These various tools help educate the user about taxonomy while aiding identification.

The book will be very useful for those in the target region but also far beyond. The beautiful illustrations are pieces of art in themselves and the clear descriptions of the many orchids and other species could be used to identify the same species elsewhere. The lavish colour-illustrated glossary would be a great resource for any student of botany in its own right.

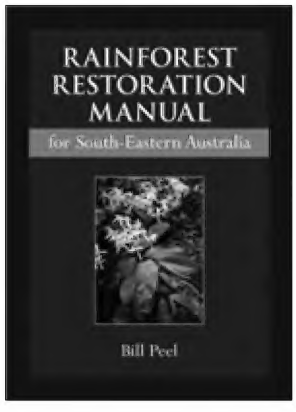
I would not hesitate to recommend adding this book to any botanical library. As a botanist I need to use a variety of texts to identify plants, and this book will add immensely to my tool kit of references.

Lincoln Kern, Practical Ecology Pty Ltd, Preston, Vic.

Book Reviews (cont.)

Rainforest Restoration Manual for South-Eastern Australia

by Bill Peel
Publisher: CSIRO Publishing, Collingwood, Vic., June 2010
352 pages with colour photographs
Paperback and CD, ISBN: 9780643094710, AU$120.00
Available from: www.publish.csiro.au



This book is an absolute treasure trove of useful information about rainforest regeneration in south-eastern Australia. The author, Bill Peel, is an experienced field botanist, ecologist and bush regenerator who has worked in the natural resource management sector in various government, community and consultancy roles over the last 30 years, and was a founding member of the East Gippsland Rainforest Conservation Management Network.

The book draws upon Peel's vast knowledge of rainforest ecology and restoration in south-eastern Australia. It rewards the patient reader with many gems of information scattered through its 352 pages or on the accompanying CD, which contains many additional resources including 32 appendices and a propagation manual for the region's 735 rainforest plants. Sections cover rainforest ecology, how to determine what kind of rainforest (if any) occurs at a proposed restoration site, immediate actions to control threats, restoration methods, funding sources, project planning and implementation, how to judge restoration success and ongoing management.

In terms of the geographical region covered by the manual, there is a serious misrepresentation of its scope on the back cover blurb, which states: "*Rainforest Restoration Manual for South-Eastern Australia* is the definitive guide to the recovery and restoration of Subtropical, Warm Temperate, Cool Temperate, Gallery, Dry, Dry Gulley and Littoral Rainforests from south-eastern Queensland to Tasmania". In reality the book only deals with regions between Batemans Bay, southern New South Wales, which is more than 1000 km south of the Queensland border, and Wilson's Promontory in Victoria. It does not cover Tasmania, Queensland or New South Wales north of Batemans Bay.

The geographical scope needs to be explicitly stated, because much of the information is of limited relevance to northern New South Wales and southern Queensland rainforests (with which I am familiar). In those areas the rainforest communities (species composition, diversity and ecological processes) and consequent specific restoration strategies are different. I suspect its relevance to Tasmania will be limited too. Unsuspecting purchasers who have forked out $120 could be very disappointed to find that the manual does not cover their area.

The book is described as a manual, with an intended audience of "students and teachers, novices, experienced practitioners, community groups and agencies", and one would expect a manual to be clearly set out with important information easy to locate. Unfortunately this is not always the case. This book is written in a conversational way with Peel providing numerous personal opinions, observations and homespun wisdom. This style brings warmth to the writing, and the reader may be infected with the author's passion for the cause. On the other hand, however, the rambling and digressive style can at times make locating information frustrating and difficult, especially when combined with numerous cross-references to information on the CD, including tables, figures, appendices, maps, glossary and references. This can be irritating, because unless you sit in front of the computer reading the book it is not convenient to locate CD resources, so the tendency is to simply not bother. Another minor gripe is the use of bold italics for all words that are included in the glossary. This is visually distracting, and tends to break up the flow of the text and, unless you are sitting at the computer, you can't check the glossary anyway.

The lack of clear organisation and the inaccessibility of important sections is more than a minor irritation. In one glaring example the reader is told that an important part of the procedure when planning a restoration project is to identify the rainforest type present or likely to have been originally present at the proposed restoration site (Step 2: What type of rainforest was it?). As part of this step the reader is directed to a series of keys to identify the Ecological Vegetation Class (EVC) and floristic community, and so access a list of species for planting (and to confirm correct community identification). These keys are located on the CD in a file called "Definitions" (a rather opaque title), which is 91 pages long but doesn't have an index, so the reader needs to scroll through until the start of the key is eventually located (on page 18). Additionally, no page numbers are provided within the key to assist in locating the EVC once it is keyed out. Finding the keys is made even more difficult by the fact that the start of the key is not clearly differentiated from the preceding text. It would have been much more convenient for ready reference and use in the field to have the keys included in the printed manual.

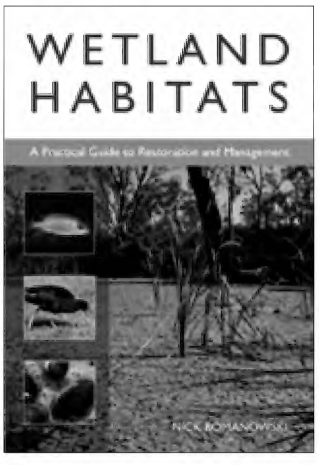
Notwithstanding the above comments, this book will prove a valuable resource for rainforest restoration in southern New South Wales and Victoria because of the wealth of practical information it contains. It is a shame, however, that editorial and organisational deficiencies detract from what otherwise would be a very good manual.

Claudia Catterall, Rainforest Ecologist, Eltham, NSW.

Book Reviews (cont.)

Wetland Habitats: A Practical Guide to Restoration and Management

by Nick Romanowski
Publisher: CSIRO Publishing, Collingwood, Vic., May 2010
216 pages including colour photographs, illustrations
Paperback, ISBN: 9780643096462, AU$49.95
Available from: www.publish.csiro.au



Wetland Habitats: A Practical Guide to Restoration and Management is the new companion guide to Nick Romanowski's best selling *Planting Wetlands and Dams: A Practical Guide to Wetland Design, Construction and Propagation.* The two books are birds of a feather. Adopting an identical practical no-nonsense approach to its predecessor, this guide takes the reader on a comprehensive step-by-step journey through the key considerations, practicalities and pitfalls involved in planning and managing a wetland for its habitat and biodiversity values.

Two central narratives run strongly through the book. The first is that wetland management and restoration should not be based "on a set of cliches and aphorisms" but rather should be underpinned by "knowledge based on the ever increasing literature and science of various aspects of wetland ecology". The second associated narrative is that knowledge is at its most powerful if it is applied within the structure of clearly stated goals and objectives.

In keeping with these narratives and philosophies Chapter 1 starts by asking the critical question 'What is habitat?'. Romanowski points out the term habitat has been used so loosely and ubiquitously in wetland management that it has begun to lose its meaning. Using the example of common and adaptable birds such as the Sacred Ibis or the Pacific Black Duck being used as measures of the success of habitat creation, he pointedly states that "all it proves is that water is present". He challenges us to deepen our understanding of habitat values beyond our human aesthetics and perceptions of what constitutes a good wetland, including our natural anthropomorphic attachments to higher vertebrates such as birds.

Through the use of examples exploring individual wetland species' life cycles, their requirements for survival and their interactions with their environment and with each other, Romanowski uses chapters 1–3 to paint a picture of the true complexity encompassed within the word 'habitat'. The picture of the complex web of interactions that influence habitat values is cleverly used to educate the reader, while simultaneously reinforcing the importance of having as deep an understanding as possible about the ecology of wetland systems to adequately inform their management.

The complexity of individual species habitat requirements is also used to illustrate the importance of having clearly stated habitat management objectives which are guided by the species-specific biology of any plant, animal or community we might be aiming to maintain habitat for. In chapters 10–14 this is supported by the provision of useful background information about the habitat requirements of wetland plants, invertebrates, fishes, amphibians, reptiles, birds and mammals as well as a comprehensive selection of Recommended Readings.

In chapters 4–6 Romanowski explores the impacts on Australian wetlands that resulted from the European colonisation of this country, including the impacts the alien plants and animals they brought with them have had on the fragile web of interactions and resources that constitute wetland habitats. In Chapter 7, against the backdrop of the extensive modification wrought on wetlands in the last 200 years since European colonisation, Romanowski outlines his 'repair' orientated wetland management philosophy where "management is actually a type of repair work ... and the starting point for all management must be an understanding of what the natural processes we are trying to restore originally were". He comprehensively explains the impacts human activities and feral species have had on wetlands, and the layers of complexity these impacts have added to the task of achieving effective habitat management. In chapters 8–9 Romanowski fleshes out his management and restoration philosophy further, as well as looking at captive breeding programs and habitat management in created wetlands and dams.

The book is well structured and packed with helpful hints, facts and useful advice reinforced by clear explanations of the rationale and the science underpinning his recommendations. For me, the greatest value of *Wetland Habitats: A Practical Guide to Restoration and Management* lies in the clarity and the honesty of Romanowski's practical outcome-driven approach to habitat management.

The importance of having well thought out and clearly stated goals and objectives is a recurring theme. Romanowski stresses this throughout the book as being critical to achieving meaningful and high quality wetland restoration outcomes (i.e. if you don't know where you are going, how can you expect to get there!). Likewise the need to underpin management decisions wherever possible by the best available science is constantly reinforced (i.e. if you don't know the effects of what you are doing, how can you expect to get there!). But perhaps

Book Reviews (cont.)

most importantly Romanowski challenges us always to weigh up all the information available as honestly and objectively as possible. This is so that each management decision is based on as sound, rational, and where possible as scientific a basis as possible, as opposed to based "on a set of cliches and aphorisms" lazily and uncritically received (i.e. if you can't explain why you are doing it, why are you doing it!). While these three key points may seem to be stating the obvious, anyone who is involved in environmental management will know how infrequently these core principals are honestly and rigorously applied in practice. Romanowksi is to be congratulated for so passionately championing their cause.

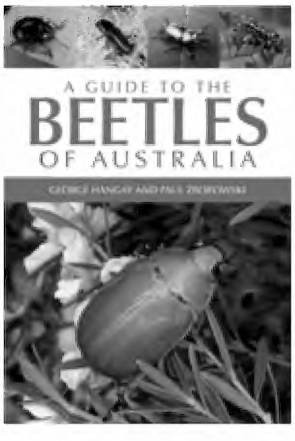
My only criticism of the book is its old fashioned text-heavy formatting. The solid blocks of text would have been more attractive and functional if they were interspersed with the relevant photos, which are excellent but inconveniently lumped in the middle of the book. However the quality of the structure and content of the text more than makes up for the occasional inconvenience engendered by the layout.

Wetland Habitats: A Practical Guide to Restoration and Management is a worthy companion to Nick Romanowski's best selling *Planting Wetlands and Dams: A Practical Guide to Wetland Design, Construction and Propagation*. Like its companion volume, Wetlands Habitats is a comprehensive, authoritative, practical, accessible, engaging and easy to read guide covering the key issues influencing habitat management in Australian wetland systems. I would recommend Wetland Habitats both for people with an interest in developing a greater understanding of wetland habitats, and for wetland management professionals and environmental managers more generally. All should use it as a mirror in which to judge the rigour and honesty of their own wetland habitat and land management practices.

Michael Hensen, Biodiversity Conservation Officer, Blue Mountains City Council, NSW.

A Guide to the Beetles of Australia

by George Hangay and Paul Zborowski
Publisher: CSIRO Publishing, Collingwood, Vic., April 2010
248 pages with colour photographs and illustrations
Paperback, ISBN: 978064309 4871. AU$44.95
Available from: www.publish.csiro.au



Reflecting on time I spent with the late Australian and international weevil expert, Elwood Curtin Zimmerman, perhaps best highlights the enormity of our beetle diversity. When in his early eighties and after having published five rather hefty volumes just on the weevil group of beetles, covering over half of the estimated 6500 weevil species known, he described his remorse at not having started to write what he had done much earlier. At his own expense he continued this work during his remaining years until 2004 (aged 92), and provided for his work to continue at CSIRO. Three more volumes are on their way as a result of this endowment.

Although this CSIRO guide to beetles could not be a complete field guide to the suborders, superfamilies, and families of beetles in Australia, which comprise 40% of all known insects, it is a brilliant start on where to look further, or at least to put the species into a superfamily or family.

The introductory pages provide an insight into the enormous amounts of information available on Australian beetles, and the equally enormous gaps in our knowledge. The authors state that every person studying beetles, professional or amateur, contributes something to science, with even the seemingly most unimportant observation or recorded data adding to the knowledge of beetle diversity.

Sections are provided on the life cycle of beetles, and food and survival, where there is also discussion of the inter-relationship between plants and beetles. It is critical for plant conservationists and bush regenerators to consider the authors' observation that the pollen and nectar feeding beetles simply starve to death when flowering finishes unless they can swap from flower to flower. That plant-eating beetles are considered by the authors' as fussier than most, may also require consideration in planting and restoration projects.

Apart from using plants, some beetles use ants and termite nests as hosts (eating ants and termites, hunting parasitic mites in the nest, or eating refuse and debris in the nest), others are dung or carrion eating, a few are parasites on mammals, and most fascinating is the Ambrosia beetle which cultivates and farms fungi (securing its food supply).

The guide provides a detailed description of what makes a beetle and of their anatomy, and includes a small section on the higher taxonomy. These sections were useful for me, as I was on a refresher course and expanding journey in taxonomic jargon. The guide has a large number of photos

Book Reviews (cont.)

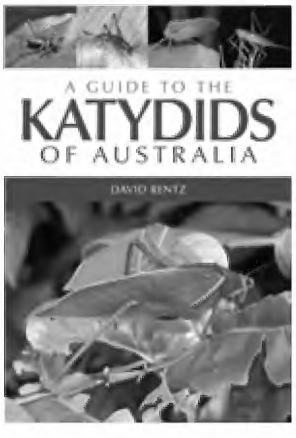
that also assist in placing specimens into a family. Each family description provides details of its distinguishing characteristics, the habitat and microhabitat in which the beetles in the family can be found, the broad distribution of the family and, where known, information on their feeding and biology.

This guide is brilliant and is only lacking a section on where to get more information (although given our access to the internet this is probably irrelevant), and could benefit from the inclusion of a list of larval and adult food plants. I believe this guide will enthuse and assist many to take on the beetle challenge as an intrinsic part of their plant conservation activities.

Maria Matthes, Ecological Sustainability Consultant, Healing History, Bagotville, NSW.

A Guide to the Katydids of Australia

by David Rentz
Publisher: CSIRO Publishing, Collingwood, Vic., June 2010
224 pages including colour photographs
Paperback, ISBN: 9 78064309 5540, AU$49.95
Available from: www.publish.csiro.au



The katydids guide suggests that there are many more katydid species to be found and new locations to be discovered. There are 14 subfamilies in the order Orthoptera (e.g. grasshoppers, katydids, crickets), five of which are endemic to Australia. The author of this guide is retired, and stresses that there is so much to be done, hoping that the guide stimulates more interest in this group. With the taxonomy of Australian katydids only partially documented, and only three of the likely six volumes of Tettigoniidae (the family in which the katydids belong) written as yet, it seems the author could do with some help.

The guide presents diagrams of the anatomy of katydids which assist in following the descriptions in the remainder of the book, and to distinguish a katydid from a grasshopper, cricket or other Orthopteran species. The author provides some descriptions of differences and a reference on where to seek further help if confused.

An informative section is provided on the biology of katydids, including reproduction, growth and development, food and feeding, and enemies of katydids. Of particular interest are that:

- katydids are mostly nocturnal;
- katydids blend in with the foliage they inhabit, and are masters of camouflage;
- food of katydids includes foliage, flowers, seeds, fruit and other insects, and they have a highly specialised habit of nectar and pollen feeding; and
- some katydids can contribute to pollination of some flowers, whilst eating others, perhaps a symbiotic relationship.

A section on the collection and study of katydids outlines the collection equipment, methods, processing and storage. This is followed by a short section on the habitats of katydids, suggests which they can be found anywhere there is vegetation.

Before introducing the subfamilies and tribes, there is a brief discussion on the conservation of katydids. It is interesting to note that the author considers the localised nature of the distribution of many katydid species has been a useful tool for habitat preservation, recognising that many are relicts of another biota of former times, some of which are clinging to their existence—like many of our plants on which they are dependent. When discussing the range of threats, although the author is rightfully concerned at the precarious state of many invertebrate populations, some excitement can still be found in the idea that "every field trip to an unusual location is bound to yield new species or rarities".

The majority of the guide is dedicated to the subfamilies, tribes, subtribes, genera and species of the katydids included in the guide. The information provided for each subfamily is variable, with some extremely limited and others appearing well known. The number of different genera and species of plants that katydids live in (including as a predator) is somewhat large, including *Eucalyptus, Angophora, Bursaria, Leptospermum, Lomandra, Gahnia, Lepidosperma, Dianella, Pteridium esculentum, Alpinia, Triodia, Pandanus, Terminalia, Banksia, Acacia, Xanthorrhoea* and grasses.

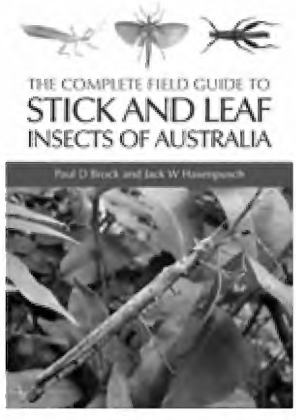
At first this guide was a little difficult to test because it is just coming into katydid season, and katydids on first appearance look like grasshoppers and crickets. However, with a little practice with specimens previously collected, it is an excellent guide and relatively easy to use, with bits and pieces of interesting information. If it is any consolation to the author, the guide has inspired me to sort my insect collection, and to spend the time identifying them as far as I can. Who knows, I might have a new or rare species, or at least a new location!

Maria Matthes, Ecological Sustainability Consultant, Healing History, Bagotville, NSW.

Book Reviews (cont.)

The Complete Field Guide to Stick and Leaf Insects of Australia

by Paul D. Brock and Jack W. Hasenpusch
Publisher: CSIRO Publishing, Collingwood, Vic., 2009
216 pages with colour photographs
Paperback, ISBN: 978064309 4185, $44.95
Available from: www.publish.csiro.au



Stick and leaf insects are known collectively as phasmids, and are often confused with praying mantids (which belong to the order Mantodea). Little is known about the 100 or so species recorded in Australia, with information about the plants they eat rarely recorded. Like the authors of the other CSIRO field guides to insects, these authors are hoping to encourage people to search and identify phasmids, learn more about them and help conserve them.

The introduction to the field guide provides some interesting facts, information about the anatomy of stick and leaf insects, and details of the stages of their life cycle. This is followed by a section on their habitat and ecology, which includes a brief discussion of the threats facing phasmids.

There is a section on collecting, preserving, photographing and rearing phasmids. Some of the food plants recorded as used by phasmids include *Eucalyptus, Casuarina, Acacia, Leptospermum, Melaleuca, Callicoma serratifolia, Litsea leefeana, Pittosporum tobira, Melastoma, Rubus, Meliocope elleryana,* and *Dendrocnide moroides*. Of interest to me was the Titan Stick Insect that has *Callitris columellaris* (the dominant species in the NSW Endangered Ecological Community Coastal Cypress Pine Forest) as one of its food plants.

The majority of the field guide is dedicated to the inclusion of all known phasmids in Australia. This section commences with an introduction to the subfamilies within the family Phasmatidae, and where the species in that subfamily can be found in the guide. The description for each species includes size, identification, habitat (including known food plants) and a note (including behavioural information).

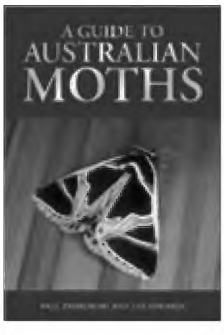
An appendix containing a key to the genera and species is provided. It is relatively simple but sends one on another journey of taxonomic jargon. Some simple supporting descriptions assist in furthering your determination. Appendix 2 provides the history of the classification of phasmids, and a checklist of the Australian taxa. The guide is completed with a great resource on where to find out more, and a useful glossary.

This is an excellent guide, and hopefully will encourage a greater interest in the conservation of phasmids.

Maria Matthes, Ecological Sustainability Consultant, Healing History, Bagotville, NSW.

A Guide to Australian Moths

by Paul Zborowski and Ted Edwards
Publisher: CSIRO Publishing, Collingwood, Vic., 2007
224 pages with colour photographs and illustrations
Paperback, ISBN: 9 78064309 1597, AU$44.95
Available from: www.publish.csiro.au



The foreword by John Landy really sums up this guide, highlighting the importance of moths as playing a vital role in pollination, as food for birds and bats (also important pollinators), and the larvae of some species in breaking down leaf litter (reducing fuel loads and facilitating nutrient recycling).

The enormous number of moth species means that a complete field guide would require several cumbersome volumes. There are 140 families of moths and about 20 000–30 000 Australian moth species known. This guide has 400 photographs, is structured to make identification of families easier, and provides useful recommendations on available resources to further identify the moth to genus or species level.

The introduction provides background to the life cycle of moths and to their anatomical features, and many interesting facts and speculations. The guide includes a section on the extinction of moths, and a discussion on the likelihood that many species have become extinct. Many species have been recorded in localised areas of large scale land clearing, have only ever been recorded once, or may not have had any recent records or collections. As so little is known about the distribution, ecology, and identification of moths, these factors cannot be assumed to imply that the species is extinct or threatened. It is likely that no-one who can recognise the species has visited known or new locations and at times when it may be detected. None-the-less moths face a variety of threats as a result of habitat degradation, land clearing and frequent fire regimes.

Book Reviews (cont.)

The majority of the guide is dedicated to identifying the moth families, providing a description of the key characteristics of each of the 69 families covered by the guide, the broad distribution of the species in the family, and the types of habitat used by them. The larval and adult food plants are identified where known. For example:

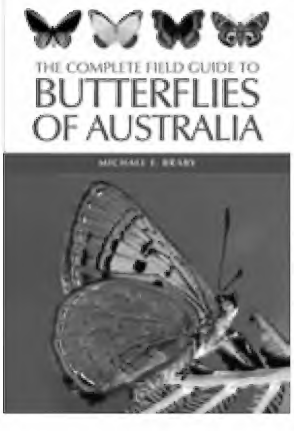
- the adults of the family Zygaenidae (Foresters) are active by day and often feed at flowers, while the larvae feed on the leaves of plants in the families Dilleniaceae and Vitaceae;
- the adults of the family Sphingidae (Hawk Moths) are voracious feeders of nectar, important pollinators, and one of the few moths that can reach the nectaries of long tubular flowers. The larvae feed on plants from many families, including Vitaceae, Rubiaceae, Balsaminaceae and Convolvulaceae; and
- the family Micropterigidae, the most primitive moths alive today, with 120 million year old fossil specimens placed in this family, has nine species in Australian rainforests. The larvae feed on liverworts, hornworts, mosses and algae, while the adults feed on pollen or fern spores.

Overall, this is an excellent field guide that would only have benefited from a checklist of the known larval and adult food plants.

Maria Matthes, Ecological Sustainability Consultant, Healing History, Bagotville, NSW.

The Complete Field Guide to the Butterflies of Australia

by Michael F. Braby
Publisher: CSIRO Publishing, Collingwood, Vic., 2004
350 pages with colour photographs and illustrations.
Paperback, ISBN: 9 78064309 1597, AU $44.95
Available from: www.publish.csiro.au



Butterflies are extremely important pollinators and little is known of their specific role in maintaining plant populations. This field guide has a beautiful foreword by the internationally renowned conservationist, Paul Ehrlich, describing his long time relationship and love of butterflies.

The introduction begins with background to these insects and makes several key points including:

- that nearly half of the butterfly species in Australia are found nowhere else;
- that Australia's unique butterfly fauna is not fully documented, with new species continuing to be discovered; and
- that much more remains to be learnt about the life histories, larval food plants, other aspects of biology and behaviour, and taxonomy if we are to conserve them adequately.

The introduction is followed by guidance on how to use the book, including how to identify butterflies. The majority of the book is dedicated to details of individual species of butterflies, divided into six sections (Skippers, Swallowtails, Whites and Yellows, Nymphs, Metalmarks, Blues) based on broad butterfly classification. For each species colour photographs of both male and female specimens, a distribution map, and known details of size, similar species, behaviour, habitat, status, larval food plants, and larval attendant ants are provided.

It is quite fascinating to explore the range of species, native and exotic, that are larval food plants for Australian butterflies, such as species of *Gahnia*, grasses (including *Phragmites* and *Imperata cylindrica*), and species of *Lomandra*, *Senna* and *Glycine*, to name but a few, as well as many of the common rainforest plants. Some of the larval food plants are threatened species, such as *Alexfloydia repens* (the host of the larvae of the Black Grass-dart butterfly), *Xylosma terra-reginae* (host for the larvae of the Bordered Rustic butterfly), and *Macadamia, Diploglottis* and *Elaeocarpus* species (that support the larvae of the Bright Cornelian butterfly). The larvae of the Samphire Blue butterfly survive on the coastal saltmarsh species *Halosarcia indica, Sarcocornia quinqueflora, Suaeda australis,* and *Tecticornia australasica.*

The book finishes with a section on where to seek further information. Overall, it is an excellent field guide that would only have benefited from a checklist of the known larval and adult food plants.

Maria Matthes, Ecological Sustainability Consultant, Healing History, Bagotville, NSW.

Information Resources and Useful Websites

Should there be an International Panel on Biodiversity?

http://www.nature.com/nature/journal/v465/n7298/full/465525a.html

The Editorial in a recent issue of the journal *Nature* questioned whether there should be a biodiversity equivalent of the International Panel on Climate Change (IPCC).

Titled 'Wanted: an IPCC for biodiversity' (*Nature* 465: 525, published online 02 June 2010), the editorial notes a recent review relating to global biodiversity loss and a proposal to establish "a body to review the science and anticipated effects of changes in biodiversity" along the lines of an IPCC body. It then discusses whether the IPCC provides an appropriate model, outlining some differences and commonalities between climate change and biodiversity loss as a global issue, and highlights what might be needed to make an independent, scientific panel achieve positive biodiversity outcomes. The on-line version of the article, and various comments relating to it, can be accessed at the web address shown above.

Managing Invasive Native Scrub to rehabilitate pastures and open woodlands

Central West Catchment Management Authority

Invasive native scrub is the thickening and encroaching of native trees and shrubs, a phenomenon considered a serious issue in the central-west and western regions of New South Wales and rangelands elsewhere. It can have a serious adverse impact on habitats, wider landscape health, communities and farming operations.

The Central West CMA has published a 144-page manual that is a comprehensive reference for strategic management of invasive native scrub and for practical decisions relating to its management at the paddock and farm scales. The manual is the result of scientific research and practical knowledge gained by many landholders who have been managing native scrub. The CMA believes the guide is practical, useful and contains the best available information on this issue.

A free copy can be obtained from Rod Campbell on 02 6881 3430 or <Rodney.Campbell@cma.nsw.gov.au>.

Barks and trunks: rainforest trees of south-eastern Australia

Peter Poropat

Dragonwick Publishing, 2009. ISBN 978-0-9806282-6-5

This book describes just over 90 tree species from rainforests in Victoria, the Illawarra, Dorrigo, border region of NSW/Qld and south-eastern Queensland. The main body of the book provides one-page profiles of each species that include colour photos of leaves, trunks and bark, and descriptions of tree habit, trunk shape, and bark, leaf and fruit characteristics. No keys are provided to distinguish between species, but two short sections before the species' profiles assist. The first contains lists of species under 'tree type' headings based on bark features (e.g. smooth barks with occasional horizontal raised lines or creases; craterous barks with small or large pustules). The second is two pages of small colour photos illustrating tree trunk shapes. The index lists the common and scientific names of all species in the book.

Fauna Sensitive Road Design Manual. Volume 2: Preferred Practices

Queensland Department of Transport and Main Roads

This is the second volume in a two-part series on fauna sensitive road design. The aim of the manual is to provide guidelines for preferred practices to reduce or eliminate the impact of road infrastructure on fauna. It provides recommendations to achieve fauna sensitive road design and includes practices that are applicable across Australia. The document is based on state, national and international research, with Australian case studies presented at the end. Copies of the manual can be downloaded free of charge from <www.tmr.qld.gov.au/Business-and-industry/Technical-standards-and-publications/Fauna-sensitive-road-design-volume-2.aspx>.

Stopping NSW's Creeping Peril: a community call for action on weeds

Invasive Species Council

This booklet provides a call for concerted action to address the growing weed problem in New South Wales. It outlines the need for reform in the way weeds are handled in the state, and provides ten recommendations to facilitate change. The document has been endorsed by over 40 organisations, including national, state and local environment groups, land care groups and bush regeneration assocations. The full report is available for download from the Invasive Species Council website at <www.invasives.org.au/page.php?nameIdentifier=stoppingnswsweedcrisis>.

ANPC Workshops

The Translocation of Threatened Plants

5 November 2010
Pottsville, Far North Coast NSW

Have you been, or would you like to be, involved in the planning, approval or implementation of a translocation project for threatened flora? Then this workshop is for you!

Questions to be addressed include:

- What is translocation?
- When it is appropriate to use translocation as a tool to conserve threatened species?
- What needs to be done when planning a translocation program?
- How should a translocation program be implemented?
- What ongoing management and evaluation is required?
- Where can I get more information?

The workshop will include case studies of translocation programs, highlighting lessons learnt. Participants will be provided with a copy on CD of the ANPC's second edition of *Guidelines for the Translocation of Threatened Plants*.

Further information and registration: www.anpc.asn.au or contact the ANPC office at anpc@anpc.asn.au or 02 6250 9509.

Managing Native Vegetation in Travelling Stock Reserves in NSW (Advance Notice)

This project will involve conducting six, two-day workshops over three years to engage on-ground managers of travelling stock reserves (TSRs) to increase their ecological knowledge and plant conservation skills. Course materials will also be developed as a resource for further workshops and other training opportunities outside the project funding and which could also be applied to other linear reserve management. ANPC plans to hold the first workshops in the Wagga region, NSW in the first half of 2011.

Further information: see the article on page 27 of this issue, or contact Sue Mathams on phone 02 6250 9523 or email sue.mathams@environment.gov.au.

Conferences and Workshops

The Art of Botanical Illustration, 10th Biennial Exhibition

6–21 November 2010
South Yarra, Vic.

The Art of Botanical Illustration is a biennial exhibition where over 150 carefully selected works depicting native and ornamental plants in a variety of media are on display and for sale. There has been a worldwide resurgence in botanical illustration where the disciplines of the artist and scientist are recorded in works of visual beauty and outstanding technical accuracy. The exhibition's growing international profile has become a focus for both artists and collectors and will be open to the public in November 2010 at Domain House Gallery, South Yarra.

Further information: www.rbgfriendsmelbourne.org

2010 Australian Systematic Botany Society Conference
Systematic botany across the ditch: links between Australia and New Zealand

29 November – 3 December 2010
Canterbury, New Zealand

The conference will explore palaeobotany, biogeography, phylogeny, algae, hybridisation, and biosecurity/weeds links between Australia and New Zealand. A field trip to Arthur's Pass will be held on 3 December, and a post-conference Bryophyte and Lichen workshop on 4–9 December.

Further information: www.landcareresearch.co.nz/news/conferences/asbs2010/

Conferences and Workshops (cont.)

Ecological Society of Australia Annual Conference Sustaining biodiversity—the next 50 years

6–10 December 2010
Canberra, ACT

The conference will celebrate the 50th anniversary of the Society, during the International Year of Biodiversity. A series of themes will focus on the challenges that will be faced by Australian ecosystems over the next 50 years, and the way that our science will need to adapt to meet these challenges. The conference will take a long-term perspective of ecology in Australia and engender a sense of urgency to consider how ecologists can provide solutions to those problems with which we are now familiar, and those on the horizon.

Further information: www.esa2010.org.au

The International Biogeography Society 5th International Conference

7–11 January 2011
Irakleion, Crete

Pre-conference workshops will be held on 7 January on the following topics: Spatial Analysis in Macroecology; Phylogenetic Analysis in Macroecology; and Communicating Biogeography. The conference commences on 8 January with symposia on Mediterranean biogeography: Where history meets ecology across scales; Comparative phylogeography—new perspectives, integrative approaches, and challenges; Biogeography and ecology: two lenses in one telescope; and Analytical advancements in macroecology and biogeography. On 10 January the program is devoted to contributed papers in six sessions: Island biogeography; Climate change biogeography; Conservation biogeography; Palaeoecology; Marine biogeography; and Hot topics in biogeography. Field trips are planned for 11 January.

Further information: www.biogeography.org/html/Meetings/2011/index.html

XVIII International Botanical Congress

23–30 July 2011
Melbourne, Vic.

Congress themes include Systematics, evolution, biogeography and biodiversity informatics; Ecology, environmental change and conservation; Structure, development and cellular biology; Genetics, genomics and bio-informatics; Physiology and biochemistry; and Economic botany including biotechnology, agriculture and plant breeding. Keynote symposia under consideration include topics such as Climate change and adaptation; Evolutionary biology of land plants; Food production: challenges and solutions; Origins of Australian and southern flora; Plant biotic interactions (including plant–insect–fungi); Plant diversity and ecology; and Plant systematics in the 21st Century.

Further information: www.ibc2011.com/Program.htm

23rd Asian-Pacific Weed Science Society Conference Weed Management in a Changing World

25–30 September 2011
Cairns, North Queensland

The conference returns to Australia in 2011 for the third time, supported by the Weed Society of Queensland (WSQ), the Council of Australian Weed Societies (CAWS) and the Asian-Pacific Weed Science Society (APWS). There will be presentations on the role of genetically modified organisms in weed management, climate change, water availability, biosecurity, population growth and the utilisation of weeds.

Further information or to register at discounted rates: www.apwss2011.com

2nd World Conference on Biological Invasions and Ecosystem Functioning (BIOLIEF 2011)

21–24 November 2011
Mar del Plata, Argentina

BIOLIEF 2011 will be a forum for the presentation, discussion, and synthesis of research on biological invasions in its broadest sense. The conference will place a particular emphasis on studies concerning the impact of invasive species on ecosystem functioning and/or services, irrespective of taxonomic groups or ecosystem types. However, studies on any other ecological aspect of biological invasions will also be welcome. Topics such as the spread of invasive species into ecosystems, the biogeography and history of species introductions, and the community- or species-level impact of biological invasions will also have an important coverage in the final conference program.

Further information: www.grieta.org.ar/biolief/

ANPC Corporate Members

ANPC gratefully acknowledges the support of the following corporate members

Albury Botanic Gardens, NSW

Approvals and Wildlife Division, Department of Sustainability, Environment, Water, Population and Communities

Australian National Botanic Gardens, ACT

Botanic Gardens of Adelaide, SA

Botanic Gardens Trust, NSW

Centre for Plant Biodiversity Research

Department of Environment and Conservation, WA

Dept of Sustainability and Environment, VIC

ForestrySA

Greening Australia, VIC

Mackay Regional Botanic Gardens, QLD

Redland City Council, QLD

Royal Botanic Gardens Melbourne, VIC

Royal Tasmanian Botanical Gardens, TAS

Sydney Olympic Park Authority, NSW

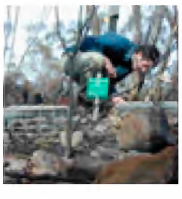
University of Melbourne, Burnley Campus, VIC

Australian Network for Plant Conservation

presents a workshop on

THE TRANSLOCATION OF THREATENED PLANTS

Friday 5 November 2010,
Tweed Bicentennial Environment Park, Centennial Dve, Pottsville, NSW



Have you been involved in, or would you like to be involved in, the planning, approval or implementation of a translocation project for threatened flora? Then this workshop is relevant to you!

Questions to be addressed include:

- What is translocation?
- When is it appropriate to use translocation as a tool to conserve threatened species?
- What needs to be done when planning a translocation program?
- How should a translocation program be implemented?
- What ongoing management and evaluation is required?
- Where can I go for more information?

Workshop Fees
(includes catering, copy of translocation guidelines & GST)

ANPC member: $115/day *Concession (ANPC member): $100/day
Non-member: $125/day *Concession (non-member): $110/day
*Concession for non-employed: e.g. full-time students, pensioners and unwaged.

Registration forms available from the ANPC:
Website: www.anpc.asn.au | Ph: 02 6250 9509
Fax: 02 6250 9528 | Email: anpc@anpc.asn.au

Registrations close: COB Thursday 28 October 2010
Numbers are limited so register early

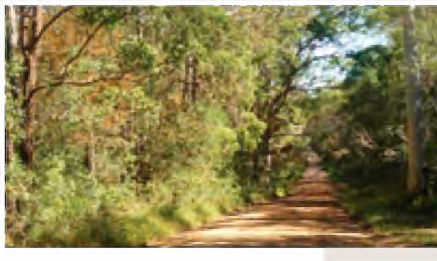
TWEED SHIRE COUNCIL

NSW GOVERNMENT Environment, Climate Change & Water

Botanic Gardens of ADELAIDE

A translocated *Allocasuarina portuensis*. Photo: Paul Ibbetson. *Haloragis eyreana* in a pot; Flowering *Leionema equestre*; Translocating *Veronica parnkalliana* plants. Photos: Manfred Jusaitis.

The NSW Roadside Environment Committee



Working collaboratively to promote and encourage best practice management of roadside and linear reserves.

NSW Roadside Environment Committee

The NSW Roadside Environment Committee:

- Supports local councils in assessing native vegetation along their roads and in producing Roadside Vegetation Management Plans.
- Encourages identification and signage of significant roadside areas and supports establishment of appropriate management plans for identified areas.
- Encourages and supports training of best management practices and monitoring for ongoing improvement.
- Supports stakeholder initiatives such as the roadside environment project – Hunter Central Coast Regional Environmental Management Strategy.
- Distributes its newsletter to stakeholder organisations to share ideas and research on linear reserve environmental management.

For further information on Significant Roadside Environment Area signs, Roadside Vegetation Management Plans, roadside environment projects or to join the mailing list for the newsletter visit the REC website

www.rta.nsw.gov.au/rec

Sponsored by:

NSW RTA

Australasian Plant Conservation
BULLETIN OF THE AUSTRALIAN NETWORK FOR PLANT CONSERVATION INC

For further information contact:
Australian Network for Plant Conservation
GPO Box 1777
Canberra ACT 2601, Australia

Ph: + 61 2 6250 9509
Fax: + 61 2 6250 9528
Email: anpc@anpc.asn.au
Website: http://www.anpc.asn.au